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# Soviet Geography: Review and Translation

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This translation and publication project was undertaken by the American Geographical Society in the conviction that the dissemination of the fruits of Soviet geographic research would be a service to American geographers and would help bring about professional contacts between geographers of the two countries. The National Science Foundation encouraged the project and is supporting it by a grant.

Readers are invited to send in their comments and discussion of articles published in *Soviet Geography*. Readers are also encouraged to submit suggestions as to published Soviet geographic literature worthy of translation. Such suggestions should relate to articles of general substantive or methodological interest rather than materials of narrow, specialized appeal.

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## TRANSLITERATION TABLE

| Russian | | | English | Russian | | | English |
|---|---|---|---|---|---|---|---|
| А | а | *а* | a | Р | р | *р* | r |
| Б | б | *б* | b | С | с | *с* | s |
| В | в | *в* | v | Т | т | *т* | t |
| Г | г | *г* | g | У | у | *у* | u |
| Д | д | *д* | d | Ф | ф | *ф* | f |
| Е | е | *е* | e* | Х | х | *х* | kh |
| Ж | ж | *ж* | zh | Ц | ц | *ц* | ts |
| З | з | *з* | z | Ч | ч | *ч* | ch |
| И | и | *и* | i | Ш | ш | *ш* | sh |
| Й | й | *й* | y | Щ | щ | *щ* | shch |
| К | к | *к* | k | Ъ | ъ | *ъ* | " |
| Л | л | *л* | l | Ы | ы | *ы* | y |
| М | м | *м* | m | Ь | ь | *ь* | ' |
| Н | н | *н* | n | Э | э | *э* | e |
| О | о | *о* | o | Ю | ю | *ю* | yu |
| П | п | *п* | p | Я | я | *я* | ya |

(*) Instead of e, use ye at the beginning of names, after vowels and after the soft sign (').

The transliteration table is supplied for the general information of readers and to enable them to identify the geographic names on maps that will be reproduced from time to time in SOVIET GEOGRAPHY.

The transliteration system is the one proposed by the United States Board on Geographic Names. For more general use in textbooks and other popular needs, the following simplifications are recommended by the editor of SOVIET GEOGRAPHY:

1. Eliminate the use of (') and (").
2. Use i for iy, and y for yy.
3. Convert diphthongs ay, ey, oy, uy to ai, ei, oi, ui.

# THE THIRD CONGRESS OF THE GEOGRAPHICAL SOCIETY OF THE USSR

## OFFICIAL REPORT

(From Izvestiya Vsesoyuznogo Geograficheskogo Ob shchestva, 1960, No. 2, Pages 105 - 6)

The Third Congress of the Geographical Society of the USSR met in Kiev January 30 to February 7, 1960. More than 1,100 persons participated, including 231 delegates from various organizations of the Geographical Society, 382 out-of-town guests and about 500 Kiev residents. (According to the Credentials Committee, there were representatives of more than 20 ethnic groups at the congress. Among the 231 official delegates, 222 had higher education, 50 had the degree of doctor of science (equivalent to a post-doctoral degree in the United States) and 113 were candidates of science (equivalent to the Ph. D. in the United States). Among the delegates were 194 staff members of scientific research and higher educational institutions. There were 204 men and 27 women.)

Foreign geographers also took part in the Congress. (They included Anthony French of London, Academician A. Beshkov and Docent Kh. Marinov of Bulgaria, Prof. A. Rado of Hungary, Prof. O. Baldacci of Italy, Prof. Trevor Lloyd and spouse of Montreal, Academician S. Leszczycki and Prof. J. Kondracki of Warsaw, Prof. M. Sirbu of Bucharest and Prof. I. Sandru of Iasi, Prof. Chauncy Harris of Chicago and Prof. R. Lonsdale of Syracuse, Docent M. Blazek of Czechoslovakia.)

There were nine plenary sessions devoted to a report on the activities of the Geographical Society of the USSR in 1955-59 by S. V. Kalesnik; a report of the Auditing Committee by I. I. Babkov; a report on international contacts of Soviet geographers by I. P. Gerasimov, discussion of the Society's report, nominations of officers, adoption of a general resolution, and short statements by the authors of papers presented on six major scientific problems included in the program of the Congress. These problems were: (1) The role of geography in the study, utilization, conservation and renewal of natural resources; (2) economic regionalization of the USSR; (3) natural (physical-geographical) regionalization for agricultural purposes; (4) general theory and practical application of landscape study methods; (5) the heat and water balance of the earth's surface and (6) the status of geography in middle and higher schools in connection with the reform of middle and higher education.

A total of 40 papers, written by 85 authors, were submitted on these problems in preprint form and distributed to Congress members. (Publication of the main Congress reports and of these preprinted papers began in Soviet Geography in May, 1960.)

A total of 236 persons took part in the discussion of the Society's report and these papers, taking up 14 sessions. Twelve statements were made by foreign geographers. Comprehensive decisions were adopted on all questions discussed at the congress.

The premises of Kiev University, where the Congress took place, contained a large exhibition portraying the activities and publications of many branches and sections of the Geographical Society, of Moscow University, the Institute of Geography of the Academy of Sciences USSR, the Geographical Publishing House (Geografgiz), the Main Administration of the Hydrometeorological Service, the editorial office of the Morskoy Atlas (Marine Atlas), the Arctic Institute, the Hydrographic Administration of the Soviet Navy and other institutions.

The Congress re-elected Yevgeniy Nikanorovich Pavlovskiy president of the Geographical Society of the USSR.

The following members were elected to the Council of the Society: D. L. Armand, M. I. Belov, M. I. Budyko, V. Kh. Buynitskiy, P. N. Buriaka, V. A. Varsanof'yeva, M. B. Vol'f, Ye. Ye. Voronov, Ya. Ya. Gakkel', N. A. Gvozdetskiy, I. P. Gerasimov, Ye. F. Gur'yanova, F. F. Davitaya, A. V. Darinskiy, L. A. Demin, N. V. Dumitrashko, Yu. K. Yefremov, M. M. Yermolayev, I. D. Zhongolovich, A. G. Isachenko, S. V. Kalesnik, F. P. Kalinin, N. G. Kell', A. M. Komkov, O. A. Konstantinov, I. B. Kostrits, E. M. Murzayev, S. V. Obruchev, B. P. Orlov, I. D. Papanin, M. P. Petrov, V. V. Pokshishevskiy, L. Ye. Rodin, A. M. Ryabchikov, K. A. Salishchev, Yu. G. Saushkin, B. N. Semevskiy, V. A. Snezhinskiy, N. N. Sokolov, A. I. Solov'yev, B. V. Sochava, Ye. Ye. Shvede, A. A. Shoshin and A. P. Yushchenko. (The composition of the preceding Council appeared in Soviet Geography, May 1960, p. 48.)

The Congress decided that the Council would include, in addition to its regular membership, the honorary members of the Society, the chairmen of the geographical societies of union republics and the chairman of the Siberian Bureau of the Society.

The new position of chief secretary (or general secretary) was established within the central organization of the Society. The secretary is to be elected by the Council from within its membership.

The following persons were named members of the Auditing Committee: I. M. Afanas'yev, I. I. Babkov, I. M. Bogushevich, A. V. Yegor'yeva, N. M. Kovyazin, I. V. Korostel', Ye. N. Lukasheva, A. I. Matveyev and P. N. Stepanov.

At its first meeting on February 7, 1960, the new Council elected the following officers of the Society: I. P. Gerasimov and S. V. Kalesnik, vice presidents; Ye. Ye. Voronov, secretary; L. A. Demin,

O. A. Konstantinov, S. V. Obruchev, L. Ye. Rodin and Ye. Ye. Shvede, Presidium members.

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(Following are additional papers presented in the congress symposium on natural (physical-geographic) regionalization of the Soviet Union for agricultural purposes. The first paper in the series appeared in the October, 1960 issue of Soviet Geography.)

## THE PHYSICAL-GEOGRAPHIC REGIONALIZATION OF THE USSR FOR AGRICULTURAL PURPOSES

By N. A. Gvozdetskiy

Research in the physical-geographic regionalization of the USSR for agricultural purposes, the organization, principles and results of which are the subject of the present report, is part of the inter-university study program in the natural and economic-geographic regionalization of the USSR for agricultural needs. This program began in 1956 and expanded considerably in subsequent years.

In May, 1956, the Ministry of Higher Education of the USSR and Moscow University convened the first inter-university conference on regionalization of the USSR at Moscow University. In accordance with its resolution, teams of geographers, soil scientists and biologists of most Soviet universities, agricultural and other colleges joined in the work of regionalizing the territory of the USSR for the purposes of agricultural planning and rational land use. To guide and coordinate this research, a Central Scientific-Methods Bureau for the natural-historical regionalization of the USSR was created under the Ministry of Higher Education (chairman Prof. D. G. Vilenskiy). Under that bureau came the Scientific-Methods Bureau on Physical-Geographic Regionalization, which heads the physical-geographic section of the work. The Scientific-Methods Bureau keeps in touch with the authorized agents for physical-geographic regionalization, who are staff members of universities responsible for the organization of work on the major parts of the USSR (see table on Page 6).

No responsible universities or authorized agents were designated for Turkmenia, Uzbekistan and Tadzhikistan because the regionalization of most of Soviet Central Asia has been undertaken by the Council for the Study and Development of Productive Forces of the Academy of Sciences USSR. In an official letter to the Chairman of the Central Scientific-Methods Bureau, the Council stated that it had data for the physical-geographic regionalization of Soviet Central Asia and that the data should be generalized by the same staff members of the Academy of Sciences USSR who had done the field work. This letter declared outright that work on the physical-geographic regionalization of Soviet Central Asia by the universities would be a

Territorial Division of the USSR with Names of Universities Charged with Guidance of the Work on Physical-Geographic Regionalization

| | |
|---|---|
| 1. Northern and Northwestern Oblasts and Autonomous Republics | Leningrad University<br>Authorized agent: Doctor of Sciences N. N. DzensLitovskaya; since 1959, A. G. Isachenko |
| 2. Baltic Republics | Latvian University<br>Authorized agent: Docent A. I. Yaunputnin |
| 3. Belorussian SSR | Belorussian University<br>Authorized agent: Docent V. A. Dement'yev |
| 4. Ukrainian SSR and Moldavian SSR | Kiev University<br>Chairman of the Ukrainian Scientific-Methods Bureau on Regionalization, Prof. V. P. Popov |
| 5. Central Non-Chernozem Oblasts | Moscow University |
| 6. Central Chernozem Oblasts | Voronezh University<br>Authorized agent: Prof. F. N. Mil'kov |
| 7. Volga | Kazan' (Middle Volga) and Saratov (Lower Volga) Universities<br>Authorized agents: Prov. A. V. Stupishin, Docent P. S. Kuznetsov |
| 8. Urals | Perm' University<br>Authorized agent: Docent B. A. Chazov |
| 9. Northern Caucasus and Lower Don | Rostov University<br>Authorized agent: Prof. D. G. Panov |
| 10. Georgian SSR | Tbilisi University<br>Authorized agent: Docent M. S. Saneblidze |
| 11. Armenian SSR | Yerevan University<br>Authorized agent: Docent K. O. Oganyan |
| 12. Azerbaydzhan SSR | Azerbaydzhan University<br>Authorized agent: Docent N. K. Keremov |
| 13. Western Siberia | Tomsk University<br>Authorized agent: Prof. G. G. Grigor |
| 14. Eastern Siberia and Far East | Irkutsk University |
| 15. Kazakh SSR | Kazakh University<br>Authorized agent: G. G. Muravlev |
| 16. Kirghiz SSR | Kirghiz University<br>Authorized agent: Docent B. A. Lunin |

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duplication of the Council's proposed work. Unfortunately, the Council has not fulfilled the obligations undertaken by it in spite of a reminder from the Scientific-Methods Bureau on Physical-Geographic Regionalization and a resolution of the inter-university conference that it fulfill those obligations.

It must also be noted that some universities and authorized agents have been unable to cope with their assignments. Irkutsk University, for instance, has been completely inactive (work on the first stage of regionalization of Eastern Siberia and the Far East had to be done by Moscow University); and Kazakh University (authorized agent G. G. Muravlev) has not established the necessary contact with the Academy of Sciences Kazakh SSR and has not done any work on the regionalization of Kazakhstan.

Soviet Central Asia and Kazakhstan have therefore been only partly covered by the inter-university work on physical-geographic regionalization for agricultural purposes. The Central Asian University has done work on individual oblasts of Uzbekistan, but outside the control of the Scientific-Methods Bureau in view of the fact that the work was to be performed by the Council on Productive Forces and no authorized agent had been designated from the Central Asian University for liaison with the Scientific-Methods Bureau.

The first inter-university conference on regionalization worked out the bases for the principles and methods of physical-geographic regionalization of the USSR. These were refined and adopted as instructions at the second conference, held in February, 1958. The same conference and the third (in May, 1959) examined the regional schemes submitted by several universities for the parts of the USSR assigned to them.

The physical-geographic regionalization of the USSR takes into account the genesis of the area and the causes and conditions of separating physical-geographic areal units (genetic principle). It considers the genesis of the whole complex of natural conditions, not merely relief or some other component (the landscape-genetic principle). In addition, it takes into account the present structure of the geographic environment and present-day physical-geographic processes depending: (a) on latitudinal landscape zonality, (b) on landscape "provinciality" (marine, transitional, continental and monsoon provinces), (c) on altitudinal zonality (belts), (d) on azonal geologic and related geomorphic characteristics of areas and (e) on the character of the use and degree of economic development of the area. The structure of the geographic environment of the region is expressed in the combination of typologic landscape units.

In regionalizing, attention is focused on those natural conditions and processes that are especially important for the agricultural use of the area (climatic conditions, soil and fodder resources, erosion processes and dissection of the area) and the historically constituted combinations of agricultural lands are analyzed. The properties of the geographic environment important for agricultural production are thus brought out.

In the present state of study of the physical geography of the USSR it is unavoidable that various methods of regionalization should be applied with mutual control of results obtained, but the basic method proposed by the inter-university conferences calls for entering the boundaries of regions

on a typologic landscape map (map of the types of physical-geographic complexes), taking into account the genesis of the geographic environment of the various parts of the area. The landscape-typology approach reflects the structure of the geographic environment depending on the above-enumerated factors.

If there is no available typologic landscape map and none can be compiled, other methods are applied. They include the leading-factor method, revealing the basic reason for separating a given physical-geographic areal complex (in this sense it does not contradict the genetic principle of regionalization) and the method of comparing and analyzing the contours of special-purpose maps (geomorphic, geologic, soil, geobotanic), which makes it possible to note the typology of physical-geographic complexes and thus to arrive at a regionalization of the area. In the latter case mainly special topologic maps are used rather than maps of particular regionalization.

An analysis of natural conditions takes account not only of qualitative, but also of the quantitative indices important for agricultural production in the area as a whole and in key sectors.

The following system of basic taxonomic units of regionalization was recommended:

(1) Physical-geographic country (strana) (Russian Plain, Urals, West Siberian Lowland).
(2) Physical-geographic (landscape) zone (distinguished within a country, i.e., it is a section of a zone within a country; for example, the forest-steppe of the Russian Plain or the steppe zone of the Russian Plain).
(3) Physical-geographic (landscape) province (oblast) (Black-Sea Steppe Province, Trans-Volga Steppe Province, Altay Province).
(4) Physical-geographic (landscape) subzone (subprovince in mountains).
(5) Physical-geographic (landscape) okrug (if needed).
(6) Physical-geographic (landscape) rayon; if necessary, an additional division into subrayons is introduced.

A few explanations must be given regarding the higher units of the taxonomic system, inasmuch as Soviet physical geographers disagree over their identification and that question has fundamental significance.

In nature there exist zonal and azonal physical-geographic area complexes of a higher order. (In this connection see also V. I. Prokayev, Fiziko-geograficheskoye rayonirovaniye SSSR (Physical-Geographic Regionalization of the USSR), lectures given at the Sverdlovsk Teachers College, Sverdlovsk, 1959.)

Examples of zonal units are the landscape zones distinguished by L. S. Berg over the whole area of the USSR from the extreme west to the

Far East. These are complex units reflecting not merely a zonality of soil and plant cover, which is governed in turn by the zonality of climatic conditions, but also a zonality of the runoff, of landscape-geochemical processes, and partly of geomorphic processes. But the complexness of these units is to a certain extent incomplete because they extend in broad zones across diverse structural-tectonic and geomorphic units of a higher order. In various parts they consequently have very diverse geologic structure, lithologic foundation and history of relief formation, and it is therefore difficult to speak of any unity of geologic-geomorphic characteristics within the landscape zones thus identified.

On the other hand, let us consider an azonal unit of a higher order; say, the Alpine geosynclinal region of Eurasia. This is not merely an orographic and geologic-geomorphic unit. It is also a complex because it reflects certain common hydrologic and climatic laws connected with mountain relief (glaciation at high elevations, the increase of runoff with altitude, altitudinal temperature zonality and hence the pronounced character of the altitudinal landscape zonality, though of a highly diversified structure). But this complex, too, is incomplete: the Alpine geosynclinal region passes through the most diverse climatic provinces, such as the Mediterranean, Continental West Asian and Central Asian, and the Monsoonal Southern Asian. Hence natural conditions in various parts are so different that one cannot speak of a similarity of geographic environment as a whole, even in relative terms. Sometimes, it is true, azonal units of a higher order may coincide with the areal units of complex regionalization, i.e., have a common structure of the geographic environment in its full complex sense.

Complex physical-geographic (landscape) regionalization should take into account both the zonal and the azonal aspects of the geographic environment, the zonal and the azonal complexes of natural conditions, the existence in nature of zonal and azonal units (incomplete complexes) from the highest levels of a regional scheme to the lowest. The principle of complexity is the basic principle of complex physical-geographic, or landscape regionalization.

The fact that the lower units -- rayons and okrugs -- have both zonal and azonal features of natural conditions must be self-evident. (This is also discussed in A. G. Isachenko, Osnovnyye voprosy fizicheskoy geografii (Basic Questions of Physical Geography), Leningrad, 1953). But how can theprinciples of zonality and azonality be combined in distinguishing areal units of a higher rank without disturbing the principle of complexity?

In the inter-university work on physic -geographic regionalization of the USSR we proceed as follows:

The country is distinguished as the highest taxonomic unit in the regionalization of the USSR. It has common tectonic and related orographic bases, a certain degree of continentality of climate and, in general, lies within a major climatic province and has certain common structural characteristics in its landscape zonality. Thus, the identification of a country takes into account both azonal features, connected with the geo-structure and the climatic "provinciality", and the structure of the zonality.

Examples of countries have been named above. They are the Russian Plain, minus its extreme northwestern and southeastern parts, and the West Siberian Lowland.

The Russian Plain corresponds to the platform of the same name, has a slightly dissected relief of hills and lowlands. It lies in a continental, but a temperately continental climatic province and is characterized by a distinct latitudinal zonality of landscapes of definite structure, i.e., a definite spectrum of zonality. Why are the northwestern and southeastern parts separated from the Russian Plain? They do not satisfy all the diagnostic features of a country. The northwestern part belongs to Fennoscandia, the southeastern to Central Asia (a sharply continental, not a temperately continental climate, and consequently a different climatic province).

The West Siberian Lowland has a different structural-tectonic foundation; a more level, more poorly drained surface having a different structure; a more continental climate; and a distinctive latitudinal zonality of landscapes, but with another zonal composition and another spectrum.

The zone serves as our unit of the next (downward) rank. But zones are distinguished within countries. Essentially, these are sections of zones. The zone is not characterized by zonality structure, but by the dominance of a definite type of zonal landscape. The identification of a section of a zone within a country predetermines common features in the morphostructure within that areal unit. The principle of complexity is therefore not disturbed.

Some Soviet geographers, particularly Yu. P. Parmuzin ("On the system of taxonomic units of physical-geographic regionalization." Nauchn. dokl. vyssh. shk., geol.-geogr. nauki, No. 1, 1948) and F. N. Mil'kov ("The problem of the zonal and the provincial in physical-geographic regionalization." Tezisy dokl. Soveshch. po yest.-istorich. rayonir. USSR dlya tseley sel'skogo khozyaystva, Kiev University, 1957), propose that the belt (poyas) be regarded as the higher unit of complex physical-geographic regionalization.

It can be assumed that the belt, traversing continents and oceans, is a higher unit of an incomplete zonal complex, just as a continent is a higher unit of an incomplete azonal complex. And it would be very tempting ( to give logical order to the system of taxonomic units of regionalization) to regard a section of a belt within a continent as a higher unit of complex regionalization (just as we distinguish a section of a zone within a country).

We have thought about this possibility, but have not been able to come to a positive conclusion. In Soviet Central Asia, for example, the boundary between the belt of temperate latitudes and the subtropical belt passes through the middle of the desert zone, dividing the landscapes of a given type and corresponding only to the boundary of the subzones of the desert zone. On the other hand, landscapes of many types, ranging from northern tayga to desert, fall into the belt of temperate latitudes. The idea of distinguishing such a complex unit by the zonal principle is doubtful, especially because the most recent research points to a fundamental difference between the landscape-geochemical characteristics of the tayga and steppe zones and to a relative similarity between steppes, semideserts and deserts (A. I. Perel'man, Ocherki geokhimii landshafta (Essays on the Geochemistry of the Landscape), Moscow, 1955). Landscape-geochemical laws reflect the very essence of interrelations in physical-geographic complexes. And how then can the deserts, which have something essentially in common as a physical-geographic complex, be divided at the highest level of regionalization, while the northern part of the desert zone (together with the semideserts and steppes) is joined to the tayga, in which the interrelations between the elements of the complex are entirely different? That is why the author of this paper had to acknowledge that "the belt is a climatic unit rather than a landscape unit" ("The physical-geographic regionalization of the USSR (principles, methods, taxonomic system)," Tezisy dokladov Nauchnoy sessii, posvyashchennoy 100-letiyu so dnya rozhdeniya G. I. Tanfil'yeva, Odessa, 1957, p. 16). Should we perhaps think in terms of some other belt groupings of landscape zones that do not coincide with the climatic belts? We do not know. It seems to us that the factor of temperature differences and thermal belts should rather be taken into account in distinguishing a country. And this is actually done because location in a definite climatic province is one of the diagnostic features of a country (this is why, for example, the West Siberian country is separated from Soviet Central Asia).

F. N. Mil'kov, contrary to his theoretical views, likewise nowhere distinguishes belts in his schemes of regionalization of the USSR, but begins his division of the USSR with countries, or "parts", representing "larger regions than the natural-historical countries delimited by the Council on Productive Forces" (F. N. Mil'kov, Fiziko-geograficheskiy rayon i yego soderzhaniye (The Physical-Geographic Region and its Content), Moscow, 1956, p. 25 ff.; F. N. Mil'kov and N. A. Gvozdetskiy, Fizicheskaya geografiya SSSR (Physical Geography of the USSR), Moscow, 1958, p. 113 ff). The Ukrainian geographers also begin their complex regionalization with identification of countries (V. P. Popov and others. "A scheme of physical-geographic regionalization of the Ukrainian SSR," Nauch. dokl. vyssh. shk., geol. geogr., No. 1, 1958).

In any case we assume that the question of the recognition of the belt as a higher taxonomic unit of complex regionalization is still open. Proposals and statements on that subject have for the most part not been realized in practice. That is why we have not been able to recognize the

belt as a higher taxonomic unit in the physical-geographic regionalization of the USSR for agricultural purposes. A great collective effort can be based only on more or less settled and tested theoretical propositions, supported by the majority of researchers participating in the program.

No discussion of the lower levels of the taxonomic ladder of regionalization is needed. We see no fundamental differences on that question, with the possible exception of the regional treatment of the term "landscape," with regard to which we recently expressed ourselves (N. A. Gvozdetskiy. "On the typological concept of landscape," Vestn. Mosk. univers., ser. biol., pochv., geol., geogr., No. 4, 1958). We do not consider it necessary to repeat our conclusions here. In the treatment of lower and middle taxonomic units of regionalization, disagreements between Soviet geographers are mainly of a terminological nature, being mainly a consequence of the habit of each researcher to use a given term in a definite sense. A uniform terminology is of course desirable, and the inter-university conferences on regionalization therefore recommended a definite taxonomic system. Unfortunately, not all participants have strictly adhered to it and this circumstance is now hampering collation of the data. There are particularly many deviations in the work of the Ukrainian geographers.

The inter-university conferences recommended that regionalization maps reflect (by colored or hatched symbols) the typologic similarity between areal units.

The scales adopted for the publication of regionalization maps are: 1:1,500,000 for the European part of the USSR, 1:1,000,000 for the Caucasus and 1:2,500,000 for Soviet Central Asia, Siberia and the Far East. Individual union republics, autonomous republics and oblasts can also be mapped at larger scales, but the larger parts of the USSR must be mapped at the recommended scales. For typological landscape maps, to be used as a basis for physical-geographic regionalization, a 1:1,000,000 scale is recommended, as in the case of the government's general geographic, geologic and soil maps. The compilation of typological landscape maps at larger scales is also recommended, especially when work is done on the basis of field data. This map work is a "key" to physical-geographic regionalization. In this connection we should like to note that the increased participation by geographers of many outlying universities in the national conferences on landscape studies held under the auspices of the Geographical Society of the USSR is undoubtedly due to the inter-university work on complex physical-geographic regionalization.

According to a decision of the inter-university conferences, the physical-geographic regionalization maps and the text descriptions are submitted in two forms: in the form of summaries by major parts of the USSR, destined for publication, and by the individual union and autonomous republics, krays and oblasts in manuscript form, for the easiest immediate practical use.

Regionalization schemes and descriptions, mainly in the form of long map legends, have now been received by the Scientific-Methods Bureau from several universities. (By December, 1959, Tartu University had sent materials on Estonia, Belorussian University on Belorussia, Kiev University on the Ukraine and Moldavia, Voronezh University on the Central Chernozem Oblasts, Kazan' and Saratov Universities on the Volga, and Kirghiz University on Kirghizia (provisional scheme). We also have Moscow University data on the Central Non-Chernozem Oblasts, Northern Caucasus, Dagestan, Eastern Siberia, the Far East, and partial data on Kirghizia and Kazakhstan.) Data continue to come in. All that will have arrived by the time of the congress will be exhibited in their original form and in the form of summary maps.

The available data have permitted us to proceed to compile a summary map of the physical-geographic regionalization of the Russian Plain and surrounding mountain systems at 1:1,500,000.

On the basis of preliminary study of these materials, the following aspects of general interest may be noted.

The Moscow University field team in the Non-Chernozem Center has come to the conclusion that mixed forests should not be distinguished as an independent landscape zone in the middle section of the Russian Plain. Such a zone was tentatively suggested by L. S. Berg (Geograficheskiye zony Sovetskogo Soyuza (The Geographic Zones of the Soviet Union), 3rd ed., Moscow, 1947, p. 82) and is reflected in the scheme of regionalization of the Russian Plain by F. N. Mil'kov (Fiziko-geograficheskiy rayon i yego soderzhaniye (The Physical-Geographic Region and its Content), Moscow, 1956, p. 69; F. N. Mil'kov and N. A. Gvozdetskiy, Fizicheskaya geografiya SSSR (Physical geography of the USSR), Moscow, 1958, p. 183). The mixed forests must be regarded as a southern subzone of the forest zone (as L. S. Berg did in his own work) because no radical changes are observed along its northern border in the landscape characteristics of the area and particularly in the soil and plant cover. The scheme of physical-geographic regionalization of the Middle Volga submitted by Kazan' University also distinguishes the mixed forests as a subzone of the forest zone. This scheme also marks the boundaries of the southern-tayga and middle-tayga subzones as the southern boundary of the forest zone.

In the south of the Non-Chernozem Center of the Russian Plain, the main zonal boundary is the border between the mixed forests and the zone with predominantly broadleaf forests, which must be assigned to the forest-steppe zone as its northern subzone (this is now mainly secondary forest-steppe). At this boundary there is a sharp change in soil conditions (turf-podsol soils are supplanted by gray forest soils) and in the plant cover, due to the instability of the moisture and the replacement of moraine and washout plains by well drained areas with a thick cover of loesslike loams. In the west of the Non-Chernozem Center this boundary runs along the

western edge of the Middle Russian uplands, south and southeast of Moscow it runs along the Oka River valley. Examination of the scheme of regionalization of the Middle Volga shows that the boundary continues eastward along the Volga valley to Kazan' and then, curving into an arc (first NE and then SE), approaches the Kama valley above Chistopol' and runs up the Kama to the mouth of the Belaya.

The work on the physical-geographic regionalization of the Non-Chernozem Center has confirmed the existence of important landscape boundaries corresponding to the limits of the Valday and Moscow glaciations. These limits have the taxonomic significance of province boundaries. Great landscape diversity was discovered in the washout plains.

The attempt to summarize the materials on the physical-geographic regionalization of the Ukraine, the Central Chernozem Oblasts and the Lower Volga has shown graphically the existing divergences in the treatment of the boundaries of the landscape zones in the southern half of the Russian Plain.

The Ukrainian geographers have distinguished three basic landscape zones: mixed forests, forest steppe and steppe. In the steppe they have drawn the boundaries of three subzones: northern, middle and southern. The boundary between the forest-steppe zone and the steppe zone at the northeastern border of the Ukraine is drawn about 160 km. farther west-northwest than F. N. Mil'kov draws it at the southern limit of the Central Chernozem Oblasts.

At the border between the Central Chernozem Oblasts and the Lower Volga, the boundary drawn by F. N. Mil'kov between the forest-steppe and the steppe does not match the same boundary on the regionalization scheme of the Lower Volga submitted by the Saratov geographers, who draw it farther north. The divergence here is about 145 km. toward the NE (along the administrative boundaries), but since the boundary between the landscape zones here extends in general from SW to NE, its displacement (nonconformity) in the summary is actually much smaller, or about 50 km. In collating the schemes of the Central Chernozem Oblasts and the Lower Volga we adopted the zonal boundary from the landscape map of V. K. Zhuchkova, which was exhibited at the fourth landscape-study conference in Riga (V. K. Zhuchkova and N. P. Lebedev, "Landscape mapping at various scales (illustrated by the Oka-Don Lowland)," Abstracts of papers at the Fourth Landscape-Study Conference in Riga, Uchen. zapiski Latv. gos. universiteta, Vol. XXXI, 1959). That position is much closer to Mil'kov's boundary between the forest-steppe and the steppe than that of the Saratov geographers.

With regard to the application of the results of the work on physical-geographic regionalization of the USSR to agricultural practice it should be noted that some university teams have already established contact with the zonal commissions of the Academy of Agricultural Sciences. For example, the members of the Non-Chernozem Center field team wrote the section

on natural regionalization for the monograph of the Institute of Non-Chernozem Farming for the Academy. The monographs being published by the zonal institutes are devoted to questions of working out a system of agriculture in different zones and should provide a scientific base for raising the productivity of Soviet agriculture.

In conclusion we list the literature published in connection with the inter-university work on the physical-geographic regionalization of the USSR for agricultural purposes. A number of sources cited below contain provisional regionalization schemes.

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# AGROCLIMATIC CONDITIONS OF THE DISTRIBUTION AND SPECIALIZATION OF AGRICULTURE

By S. A. Sapozhnikova and D. I. Shashko

Climate plays a leading role among the natural factors influencing the zonal distribution and differentiation of agriculture. Its elements -- heat, moisture and light -- are indispensable for plant life. They are assimilated by the plant organisms in the process of formation of organic matter. Hence we are entitled to regard them as the climatic resources of agriculture, which, like other natural resources, must be strictly taken into account and rationally utilized.

The predominant effect of climate on the distribution of agricultural production is confirmed by the boundaries of the present areas of cultivation of a number of crops (subtropical perennials, cotton, grapes, corn and fiber flax), which both here and abroad, particularly in the United States, are closely tied in with climatic factors.

The decisive role of weather and climate in the differentiation of farm production is also evident in the great fluctuations in crop yields from year to year and in individual seasons depending on the weather and climatic fluctuations and tillage practices under identical soil conditions.

Crop-yield fluctuations in individual years as a result of changing weather conditions are well known. Suffice it to point out the considerable reduction of the 1959 yield caused by unfavorable weather conditions in a number of regions of the USSR in spite of the general improvement of tillage practices.

As an example of crop-yield fluctuations over whole periods of years we might cite the persistent anomaly in crop yields in the southwest and the southeast of the Ukraine in the post-war years. The relatively higher yields in these years in the southwest (Odessa Oblast) compared with the southeast (Lugansk Oblast) agree with deviations from the normal precipitation and the hydrothermic coefficient (HTC) during the main part of the growing season -- positive in the former, and negative in the latter part of the Ukraine (Fig. 1). (The figures and Table 1 will be shown at the congress).

The significance of climatic factors is also shown by the successful estimates of the spatial differentiation of crop yields based on those factors in a number of studies.

In this connection we might mention the interesting research by V. M. Obukhov (1949), who established a close connection between crop yield and climatic factors. He computed regression equations for various crops, in which the precipitation, temperature and other climatic factors during

inter-phase periods were taken as the variable quantities. P. I. Koloskov (1947) established a spatial differentiation of crop yields by using the method of the transpiration coefficient.

Recently, a number of authors have made interesting findings on the connection between the crop yield and the basic climatic factors of development and growth by using the graphic method (S. A. Sapozhnikova, 1959).

In establishing a spatial differentiation of crop yields, attention should be given to methods based on correlating crop yields with evaporation (transpiration) and with the meteorological factors of evaporation because the evaporation values are an integral index of the effect of the whole multitude of environmental factors upon plants. It might be said that the most reliable methods will be those crop yield-climate correlations that best take into account the moisture evaporation factor on cropped fields.

As shown by the research of one of the authors (D. I. Shashko, 1948, 1958), the effect of the diversified complex of factors upon crop yield is reflected in the coefficient of total evaporation Mc in the formula $\ell = Mc(E-e)$, constructed on the basis of Dalton's law of evaporation. This coefficient relates crop yield to evaporation. The value of that coefficient on the average corresponds to the ratio of the annual precipitation to the sum of mean daily values of the air-humidity deficit (D. I. Shashko, 1958). It follows that the spatial differentiation of crop yields is best reflected by the values of the atmospheric humidity index in the form of the ratio of annual precipitation to evaporability and also by the values of the index in its correlated forms.

The correlation between yield and the values of the moisture index is illustrated by graphs (Figs. 2,3) (not available to Soviet Geography at time of publication).

From the graphs it follows that, besides the moisture supply, a powerful factor in crop yield is the heat supply, which governs the cultivation of the higher-yield, late-ripening ecologic types of crops.

An appraisal of the climatic resources of agriculture by zones must therefore be based primarily on the supply of heat and moisture to the plants. In the case of hibernating crops, the wintering conditions must also be taken into account. The methods for such studies have been developed by Soviet agrometeorologists: A. M. Alpat'yev (1954), L. N. Babushkin (1951), I. A. Gol'tsberg (1958), F. F. Davitaya (1938), P. I. Koloskov (1925), V. P. Popov (1958), S. A. Sapozhnikova (1958), G. M. Selyaninov (1930), V. N. Stepanov (1958), D. I. Shashko (1958), A. M. Shul'gin (1959) and others.

Let us dwell briefly upon the methods of taking into account the supply of heat and moisture to plants and the hibernating conditions of plants, adopted by the authors in compiling the map of the climatic resources of agriculture attached to this article (Fig. 4) (not available to Soviet Geography).

The map was compiled for the agrometeorology section of the Academy of Agricultural Sciences, by S. A. Sapozhnikova (NIIAK) and D. A. Shashko (SOPS AN SSSR) under the editorship of F. F. Davitaya (GUGMS), using the materials and research of G. T. Selyaninov (VIR), P. I. Koloskov (NIIAK), F. F. Davitaya (GUGMS), Ye. S. Rubinshteyn (GGO), V. N. Stepanov (TSKhA), A. M. Shul'gin (VASKhNIL), M. I. Mel'(NIIAK), M. S. Perunova (GGO), V. A. Smirnova (NIIAK), A. K. Shkodova(GGO).

(NIIAK - Scientific Research Institute of Agroclimatology; SOPS AN SSSR - Council for the Study and Distribution of Productive Forces of the Academy of Sciences USSR; GUGMS - Main Administration of the Hydrometeorological Service; VIR - All-Union Institute of Plant Cultivation; GGO - Main Geophysical Observatory, Pulkovo; TSKhA - Timiryazev Agricultural Academy; VASKhNIL - All-Union Academy of Agricultural Sciences named for Lenin.)

## Heat Supply to Plants

It is customary to regard as the basic index of heat supply to plants the sums of the temperatures for the period within which temperatures limit the development of plants. Most crops begin to vegetate perceptibly at a mean daily temperature of over $+10^{\circ}$. The heat resources of an area are therefore best described in terms of isolines of the sums of temperatures above $10^{\circ}$, which in turn yield belts and subbelts.

The agroclimatic belts are best identified by the names of the climatic (physical-geographic) belts: arctic, subarctic, temperate or middle-latitude, subtropical and tropical.

The arctic belt is bounded on the south approximately by the isoline of the sum of active temperatures above $10^{\circ}$ amounting to $400^{\circ}$. In the arctic belt, with a temperature of less than $10-11^{\circ}$ in the warmest month, farming in unsheltered ground is of no practical significance. It is mainly a belt of sheltered-ground crops. A major limiting factor is the arctic air, whose distribution prevents the development of forest vegetation. The belt corresponds approximately to the arctic and typical tundra.

The subarctic belt lies within the limits of temperature sums of 400 to $1,000^{\circ}$ ($400-800^{\circ}$ east of the Lena). It is a belt in which ground cultivation is confined to vegetable crops with a short growing period and low heat requirements: radishes, lettuce, spinach, early onions, turnips, cabbage and incompletely ripening potatoes. Agriculture is confined to sections with favorable microclimatic conditions. The long or even continuous summer day offers opportunities for cultivation in protected ground. During the summer period the arctic air is transformed into temperate-belt air with a rise of the temperature of the warmest month to as much as $+15^{\circ}$. This causes the growth of forest vegetation in the forest-tundra and the thin tayga.

The temperate-latitude belt extends southward from the isoline of

1,000°(800°) temperature sums. A characteristic climatic feature of the belt is the occurrence of four pronounced seasons (spring, summer, fall and winter); the agricultural feature of the belt is the growth of spring and winter crops that require low temperatures to pass through the vernalization stage, mainly cereals and groats, as well as fodder crops. The belt is very unhomogeneous with regard to heat and moisture combinations and must be broken down into natural zones ranging from the humid tayga in the north to the desert in the south.

The subtropical belt is characterized by two growing periods: summer and winter. Its northern climatic boundary is the isoline of the -10° mean of absolute air-temperature minimums with assured sums of temperatures above +10° amounting to at least 3,600°. The subtropical belt, especially its humid regions, is marked by a broad assortment of crops. Great importance is attached here to the cultivation of citrus fruits, tea, tung nuts, figs and grapes without winter covering.

The tropical belt is missing in the USSR.

The thermal condition of the agroclimatic belts determines the possibility of cultivating ecological groups and types of crops, as well as the type of agricultural production depending on how pronounced the seasons (spring, summer, fall and winter) are.

Typical activities in the arctic belt are crop farming in covered ground, hunting, fur farming and fishing; in the subarctic belt - ground cultivation of vegetable crops requiring little heat, crop farming under glass, reindeer raising, hunting and fur farming; in the temperate-latitude belt - ground cultivation of spring and winter crops, the keeping of livestock in barns during the winter and the pasturing of livestock in the southern part of the belt, and in the subtropical belt - year-round crop farming and livestock grazing.

Rational farming requires the fullest use of local heat resources by cultivation of the highest-yielding crops with a period of growth making the greatest possible use of the local growing season or by filling out the growing season with intertilled crops. In view of the great range of heat requirements of crops, the agroclimatic temperature belts should be divided into subbelts based on the heat supply for various ecological types of crops. There is special need for subbelts in the temperate belt, the most extensive in the USSR. A list of the subbelts of this belt is given in the legend to the map (Fig. 4) (not available).

The agroclimatic subbelts based on heat supply have been given various names by different authors. In establishing these subbelts, authors usually start with a qualitative estimate of the thermal condition of the atmosphere. An analysis of the data on temperature sums and the temperature of the warmest month shows that their values do not always correspond with one another. Depending on the degree of continentality, the temperature of the warmest month may differ even when the temperature sums are the same.

To illustrate this, we cite the following data on the longitudinal distribution of temperature (Table 2).

Table 2. Longitudinal distribution of the temperature of the warmest month

| | Longitude | | |
|---|---|---|---|
| Sum of temperatures above 10° | 30° | 50° | 70° |
| 2200 | 18.0 | 20.0 | 20.0 |
| 2800 | 20.0 | 22.5 | 22.5 |
| 3400 | 22.5 | 25.0 | 25.5 |
| 4000 | -- | 26.5 | 27.0 |

In the USSR, the difference in temperature levels between longitudes amounts to 2.5-3.0°, which corresponds to the temperature interval of a subbelt based on temperature sums. Because of this disagreement, the subbelts should be given agricultural rather than climatic names: for example, early-crop subbelt or late-crop subbelt.

In addition to distinguishing agroclimatic subbelts, there is great practical interest in the establishment of climatic boundaries of cultivated plants. Such boundaries may be determined by comparing the climatic sums of temperatures with the bioclimatic sums or with the sums that insure either the ripening of crops or the attainment of economically valuable growth phases. The climatic boundaries of certain ecological types of crops with 90% assurance of attaining economically valuable growth phases are shown in the expanded legend of the cartogram of the climatic resources of agriculture (Table 1) (not available).

In the eastern regions of the country, crops require smaller temperature sums during the growing season because of the greater continentality of climate and the greater constancy of temperature sums over the years. This is taken into account in the map (Fig. 4) by shifting the thermal boundaries of the subbelts by 100-200° and by indicating in Table 1 the climatic boundaries of crops by temperature sums of 200° less.

## Moisture Supply to Plants

The productivity of crops having a sufficient quantity of heat and other factors of growth (nutrients, light, etc.) is determined mainly by their moisture supply. The moisture supply is usually judged by the amount of precipitation during the year and in the growing season. The efficiency of precipitation as a source of water supply to plants, depends on evaporation conditions. The conditions of moisture supply to plants are therefore best described not merely by precipitation but according to the moisture index in the form of the ratio of precipitation to evaporability (possible evaporation) or the ratio of precipitation to the basic factors of evaporation (air-moisture deficit, temperature, radiation balance, etc.).

The forms of the moisture index found in the literature are closely correlated and are interchangeable.

The scale of index values adopted by the authors in different forms for measuring the moisture supply to plants is given in the legend (Table 1). The scale is derived as follows: The climatic value of the index (the ratio of annual precipitation to evaporability) equal to 1.00 corresponds to the zone with a balanced value for the two magnitudes (northern boundary of the forest-steppe). The value 0.33 corresponds to the zone where farming without irrigation is irrational (northern boundary of the semidesert). Index values greater than 1.00 reflect humid and excessively humid growth conditions; between 1.00 and 0.33, growth conditions show inadequate moisture and varying degrees of droughtiness, and less than 0.33 reflects arid conditions.

The area of inadequate moisture is further subdivided into three parts according to degree of moisture: index values 1.00-0.77 being slightly droughty; 0.77-0.55 droughty and 0.55-0.33 very droughty.

Agreement of the gradations of the moisture index in its different forms with the natural zones is shown in the legend (Table 1). This table also shows data on the probability of years with different amounts of moisture, computed from a generalized curve of the assured relative values of the moisture index.

It should be noted that there is an overlapping and, in some places, a certain deviation of the moisture-index isolines from the boundaries of the natural zones. This is to be explained not by any imperfection of the moisture index but by local relief conditions determining the distribution of soil moisture, and by the physical and chemical properties of the soil and subsoil affecting the soil-forming process. The deviation of the moisture-index isolines from the boundaries of natural zones is also determined by the degree of continentality of climate and the relationship between the lengths of the warm and cold seasons. For this reason forest growth in the Asian part of the USSR is associated with lower moisture indices than in the European part. As for permafrost regions similar in atmospheric moisture to the steppe zone (Central Yakutia, its northeastern areas, etc.), the dominance of forest vegetation is already quite characteristic. Steppe features are encountered here only in limited areas. In view of the foregoing, there is no basis for expecting complete agreement between the boundaries of the moisture zones and of the natural zones.

The moisture zones distinguished by the values of the moisture index also differ in the seasonal distribution of atmospheric moisture. This is reflected to a certain extent by the ratio of precipitation in the warm half of the year (April-Sept.) to that in the cold half (Oct.-March). The territory with a ratio greater than 2 usually has a droughty spring; that with a ratio greater than 4 a droughty spring and a relatively less humid fall; and that with a ratio of less than 1.0 has a relatively humid winter and spring, which insures the possibility of dry farming in arid zones.

## Hibernating Conditions of Cultivated Plants

Hibernating agricultural plants are divided into woody plants, including shrubs and semishrubs, to which also belong certain berry crops, and herbaceous, to which belong winter rye, wheat and barley, perennial grasses, etc.

In the first group, both the above-ground and the under-ground organs are damaged as a result of unfavorable hibernating conditions. In the second group, principally the above-ground organs are damaged. Accordingly, agroclimatic indices must be established reflecting the hibernating conditions of these groups of crops.

For arborescent crops, the air temperature in winter is the determining factor. The mean values of the absolute temperature minima are taken as the index of the temperature conditions of hibernation. This index was applied by G. T. Selyaninov (1930) in identifying regions of possible cultivation of subtropical crops in the USSR. The scale compiled for measuring the hibernating conditions of arborescent crops by the mean values of the absolute temperature minima is given in Table 1. According to that scale, the territory of the USSR was divided on the basis of the severity of the winter, and consequently the hibernating conditions.

Damage or destruction of herbaceous field crops results from freezing, sweating, waterlogging or mechanical effects. Under certain conditions the air temperature at the basal node of the stem may be taken as the general integrated index of hibernating conditions of field crops.

According to A. M. Shul'gin (1959) the normal hibernation of winter crops under conditions of a slightly or temperately continental climate proceeds mainly at a soil temperature ranging from -5 to -15° at the depth of the basal stem node. A temperature above or below these limits leads to damage or destruction of the plants.

The critical temperature for most varieties of winter wheat is -15 to -16°, and for winter rye -18 to -20°. In certain years when plant hardening starts in the fall and in regions favorable to hardening, the lower limit of the critical temperature lies considerably lower than the indicated temperature criteria. A. M. Shul'gin has generalized the data of actual observations of soil temperatures at the basal stem-node depth made at USSR agrometeorological stations. As a result, he has compiled a map showing the distribution of the mean absolute minima. From it we have transferred to our map (Fig. 4) the temperature isolines for -12 and -16°.

The most favorable conditions for the hibernation of winter grasses and perennial grasses exist in areas with a temperature higher than -12°. In the great majority of winters (80%) in these areas the minimum soil temperature at the basal stem-node depth is within optimum limits for the hibernation

of winter crops (from -5 to -15°). In certain winters at a temperature higher or lower than the optimum there may be partial damage to winter crops from sweating or freezing. In the extreme western regions of the European part of the USSR winter crops are damaged only by sweating or freezing.

On the territory bounded by the -12° and -16° isolines, damage to winter crops is possible in a series of years. Here the probability of a critical soil temperature of -16° or less at the basal stem-node depth is about 50 per cent and below -20° 5 to 20 per cent. To prevent freezing of the crops snow should be retained on the fields and hardy varieties should be cultivated.

On territory with temperatures below -16° conditions are unfavorable for hibernation of winter and perennial herbs. With artificial snow retention it is possible to cultivate hardy varieties of winter rye at some points. This also applies to areas of Eastern Siberia and the Far East with perpetual or protracted seasonal ground frost, where the temperature at the basal stem-node depth is usually lower than -20°. At that temperature the cultivation of winter rye and perennial grasses is insured by snow retention because of the more favorable conditions for hardening.

In intra-zonal specialization and distribution of agricultural production, great significance is attached not only to climate but also to soil characteristics having no direct genetic relation to the climate of the area. However, even such a soil characteristic as mechanical composition, which has little connection with climate, affects crop-raising conditions largely through a change in moisture conditions, i.e., a change in one of the leading components of climate and, consequently, can be quantitatively characterized by the agroclimatic index - the supply of productive moisture in the soil.

Hence, climatic conditions are determinant not only in the distribution of agricultural production on a national scale, but also at the level of individual republics and oblasts, and also in organizing the territories of the individual farms.

Until very recently, soil and geobotanic regionalization constituted the foundation of the regionalization of agricultural production. This is due to the fact that genetic soil types and natural vegetation are good indicators of climate. The use of these indicators was fully justified as long as a qualitative characterization of climate was sufficient.

Now, the planning of agricultural production demands a quantitative appraisal of the actual and potential productivity of natural conditions. This requires a change from qualitative characterizations to quantitative indices of the conditions governing the productivity of the individual crops and farming as a whole. This factor tends to emphasize the productive significance of climate, but does not of course eliminate the need for a proper appraisal of soil characteristics insofar as they cannot be taken into account by agroclimatic indices. In this connection let us dwell briefly upon the question of appraising the productivity of climate.

## Productivity of Climate

Regionalization of a territory according to the heat and moisture supply to plants, with established indices of the quantitative relation of crop yield to climatic factors, makes it possible to appraise the productive value of climate on a point system.

Such an appraisal is required for justifying the distribution and specialization of agricultural production, planning the procurement of farm products, ascertaining unutilized climatic resources, etc.

The method of appraising the productive value of climate is founded on the following basic propositions.

The size of yield of crops is determined by the complex of physical-geographic factors of the environment, by the level of agrotechnology contributing to the plant organisms, utilization of that environment, and by the biological characteristics of the crops, mainly the length of the growing season, but also by differences in species and varieties.

The effect of the complex of physical-geographic conditions on crop yield is shown by graphs correlating yields for a given level of agrotechnology with the values of the moisture index (Figs. 2,3) (not available).

The effect of the duration of the growing period of crops is shown by the relative stability, under identical conditions of moisture and agrotechnology, of the values of the index of climatic productivity (P), representing the ratio of crop yield in metric centners per hectare to the length of the growing period. Table 3 shows P for different crops, being the yield in centners per hectare for $100^{0}$ of the temperature sums, taken as the unit of the length of the growing period. The sizes of the crop yield (m) needed for determining P are taken from the individual graphs correlating crop yield with the values of the moisture index.

The relative stability of the values of the index of climatic productivity P makes it possible to average these values and, for the purpose of determining the productivity of the climate, to use the equation

$$m = PL,$$

where m is the calculated size of the yield in centners per hectare, P- the index of climatic productivity, and L - the length of the growing period, expressed in hundredths of the bioclimatic sum of temperatures (or the sum necessary for the annual ripening of plants).

This stability of the index of climatic productivity (P) indicates that the yield of crops having a sufficient supply of mineral food is determined mainly by the length of the growing period and that varietal differences in yields

Table 3. Mean Values of the Index of Climatic Productivity (P) for Various Values of the Moisture Index (according to seed-selection data for 1950 - 56).

| Crops | Bioclimatic sums of temperatures above $10^0$ | | Moisture Index * 0.15 (0.33) | 0.25 (0.55) | 0.35 (0.77) | 0.45 (1.00) | 0.55 (1.21) | 0.65 (1.43) | 0.75 (1.45) |
|---|---|---|---|---|---|---|---|---|---|
| Corn | 2700 | m | 14.0 | 27.0 | 34.6 | 39.2 | 41.5 | 43.0 | 43.4 |
| | | P | 0.52 | 1.00 | 1.28 | 1.45 | 1.54 | 1.60 | 1.40 |
| Winter wheat | 2100 | m | 10.0 | 18.0 | 22.2 | 25.0 | 26.2 | 26.3 | 25.4 |
| | | P | 0.48 | 0.86 | 1.06 | 1.19 | 1.25 | 1.25 | 1.20 |
| Winter rye | 2000 | m | 9.5 | 17.2 | 21.4 | 24.0 | 25.5 | 25.8 | 25.6 |
| | | P | 0.47 | 0.86 | 1.07 | 1.20 | 1.27 | 1.29 | 1.28 |
| Oats | 1500 | m | 8.7 | 16.5 | 20.5 | 22.7 | 23.8 | 24.0 | 23.4 |
| | | P | 0.58 | 1.10 | 1.37 | 1.52 | 1.59 | 1.60 | 1.56 |
| Barley | 1400 | m | 8.3 | 15.6 | 19.5 | 21.6 | 22.8 | 23.0 | 22.3 |
| | | P | 0.59 | 1.11 | 1.39 | 1.54 | 1.62 | 1.64 | 1.59 |
| Spring wheat | 1600 | m | 7.5 | 13.0 | 16.0 | 17.4 | 17.8 | 17.4 | 16.3 |
| | | P | 0.47 | 0.81 | 1.00 | 1.08 | 1.11 | 1.04 | 1.02 |
| Average | | $P_1$ | 0.51 | 0.95 | 1.19 | 1.33 | 1.39 | 1.40 | 1.38 |
| Average based on 1945-49 data | | $P_2$ | 0.56 | 0.90 | 1.16 | 1.30 | 1.36 | 1.38 | 1.35 |
| Weighted average yield for bioclimatic sum of temps. of $1600^0$ | | m | 8.0 | 14.6 | 18.6 | 21.0 | 22.6 | 22.8 | 22.9 |
| | | $P_3$ | 0.50 | 0.91 | 1.16 | 1.31 | 1.41 | 1.42 | 1.40 |

(*) The moisture index without parentheses is the ratio of precipitation to the sum of the mean daily values of the air-humidity deficit; in parentheses, the ratio of precipitation to evaporability.

apparently cannot outweigh specific differences in growing periods. This, however, does not reduce the importance of varieties. Within a given species there may be earlier ripening varieties that are higher yielding than certain late ripening varieties.

The dependence of yield upon the level of agrotechnology makes difficult the use of absolute yield values for determining the productivity of climate. This difficulty is eliminated if relative yield sizes are used, since their deviations from the average are equally regular for high and low levels of agrotechnology. This is indicated by the almost complete coincidence of the values of assured relative yield sizes computed by us from yield data of the government seed-selection system (comparatively high agrotechnology) and the pre-Revolutionary Zemstvo statistics (low agrotechnology, Fig. 5) (not available).

For determining the assured (probable) relative sizes of crop yields, we used the data on the yields of 135 seed-selection stations with an 18-year period of observation and the data of the zemstvo statistics for 44 oblasts with a 33-year period of observation. This permitted us to typify the curves (Fig. 6) (not available). The first and second types of curves characterizing the comparatively small fluctuations of yield belong to zones of insufficient moisture, while the fourth type of curve, with the greatest range of yield fluctuation, belongs to the most arid areas.

In general the curve of type II characterizes yield fluctuations in the zones of sufficient moisture, while the curve of type III applies to zones of insufficient moisture.

It is characteristic that, for the zones of insufficient moisture, the assurance (probability) of various yield sizes, expressed in percentages of the normal (average size), is of the same order as the assurance of the relative values of the moisture index (see Fig. 4). This indicates that the yield fluctuations by years at the same level of agrotechnology are determined principally by weather conditions.

In constructing the climatic productivity scale by relative yield sizes we adopted the 100-point system for convenience of use. A grain yield of 20 centners per hectare was taken at 100 per cent. This yield level is close to the national weighted average at seed-selection stations and corresponds to the average in the forest-steppe zone (with an above 10° temperature sum of less than 2400°). By this scale it is easy to determine the level of the yield for any place if the number of points is determined for it and the average yield is known.

On the basis of the correlation between yield and moisture-index values the appraisal of the productive value of the climate can be expressed in points of actual and potential productivity. The following point systems are of practical importance in appraising climate:

actual normal productivity for the average level of agrotechnology throughout the country under the existing system of farming; actual productivity at the level of agrotechnology characteristic of the given locality; potential productivity, if the usual amount of moisture is present and the fullest use is made of heat resources through the sowing of late ripening plants, intertilled crops and the harvesting of two or more crops a year; and potential productivity, if optimum moisture is assured through irrigation.

The points of normal actual productivity are established from the graph in Fig. 3, constructed on the basis of data from the whole network of seed-selection stations. To determine the points of actual productivity it is necessary to establish the mean deviations of the actual yield from the normal taken from the graph and, in accordance with it, the deviations of the points of the actual from the points of the normal actual climatic productivity.

The points of potential productivity are established from the estimated size of yield (m = PL) multiplied by 5, since according to the adopted point system a yield of 1 centner per hectare is valued at 5 points at the level of agrotechnology achieved in seed-selection stations.

The points of potential productivity with optimum moisture supply are determined by their highest values corresponding to the moisture index 0.65 (1.43).

The climatic productivity indices in points of normal actual and potential productivity for various conditions of heat and moisture supply to plants are given in Table 4 (p. 32).

The difference between the points of actual and potential productivity indicates an under-utilization of the climatic resources as a result of incomplete use of the period of possible vegetation or insufficient water supply to plants.

Incomplete use of the vegetative period must be eliminated by sowing higher-yielding late ripening crops and intertilled crops.

By using the cartogram of the distribution of temperature sums and the moisture-index values, the data in Table 4 and the equation for calculating yield, it is possible to get an idea of the actual and potential productivity of the climate of any place, not only in the USSR, but also beyond its borders. The table reveals, for example, immense unused potential climatic resources in the desert zones of the USSR. In places having assured above 10° temperature sums of 5000° the potential resources are estimated at 355 points, which, at the seed-selection-station level of agrotechnology, corresponds to 70 centners per hectare when translated into grain crops. These immense potential resources of the deserts await their exploitation under the long-range plans for the construction of a Communist society. Yield stability over time, which is one of the important indices of agricultural

Table 4. Climatic Productivity in Points of Actual and Potential Productivity

| Bioclimatic sum of temperatures above 10° | Unit of appraisal | Moisture Index: 0.15 (0.33) | 0.25 (0.55) | 0.35 (0.77) | 0.45 (1.00) | 0.55 (1.21) | 0.65 (1.43) | 0.75 (1.65) |
|---|---|---|---|---|---|---|---|---|
| | | Climatic productivity index in centners per hectare per 100° | | | | | | |
| | | 0.50 | 0.91 | 1.16 | 1.31 | 1.41 | 1.42 | 1.40 |
| 1000 | an | 25 | 46 | 58 | 65 | 70 | 71 | 70 |
| | Pp | " | " | " | " | " | " | " |
| 1200 | an | 30 | 54 | 69 | 78 | 84 | 85 | 84 |
| | Pp | " | " | " | " | " | " | " |
| 1600 | an | 40 | 73 | 93 | 105 | 113 | 114 | 112 |
| | Pp | " | " | " | " | " | " | " |
| 2200 | an | 40 | 73 | 93 | 105 | 113 | 114 | 112 |
| | Pp | 55 | 100 | 127 | 144 | 155 | 156 | 154 |
| 2800 | an | 50 | 96 | 125 | 145 | 155 | -- | -- |
| | Pp | 70 | 126 | 162 | 183 | 197 | 199 | 196 |
| 3400 | an | 67 | 118 | 148 | 164 | -- | -- | -- |
| | Pp | 85 | 154 | 197 | 222 | 239 | 241 | 238 |
| 4000 | Pp | 100 | 184 | 232 | 240 | 280 | 284 | 280 |
| 5000 | Pp | 125 | 230 | 290 | 325 | 350 | 355 | 350 |
| 6000 | Pp | 150 | 276 | 348 | 390 | 420 | 426 | 420 |
| 7000 | Pp | 175 | 322 | 406 | 455 | 490 | 497 | 490 |
| 8000 | Pp | 200 | 368 | 464 | 520 | 560 | 568 | 560 |

an = points of actual normal productivity with existing crop structure (according to graph, Fig. 3)

Pp = points of potential productivity under fullest utilization of heat resources of locality. Figures printed in italics show points of potential productivity of climate with optimum moisture (italics not reproduced in typed text of original preprint).

production, and also the synchronism of these fluctuations over a considerable territory, at a given level of agrotechnology, is determined, as shown above, by the characteristics of the climate. The range of fluctuation of the potential yield of grain crops (including corn) increases by two or three times from humid zones to zones of insufficient humidity (Table 4).

The range of the possible yield fluctuations and especially the persistence of an anomaly over several years must be taken into account, not only in planning crop-insurance funds, but in specializing both farm output and allied processing industries (for example, sugar mills). In drought-ridden regions with sharp yield fluctuations, grain crops have a clear advantage over such crops as sugar beets because grain is transportable and can be stored.

As already pointed out by F. F. Davitaya and other authors, the struggle for a stable agricultural production requires proper consideration of the asynchronism of the fluctuations of climate and weather. These make it possible, by spreading sowings over a large territory from the western borders to the Far East, to insure annually more or less stable total crops for the Soviet Union as a whole.

During the next few years, the proportion of irrigated territories will still be relatively small and yield fluctuations will largely depend upon fluctuations in the weather, while long-range weather forecasting is still unreliable. Such a decentralization of sowings is apparently the only guarantee of a stable grain supply.

If due consideration is given to possible weather fluctuations, it is possible to achieve a certain stability of yield not only in the USSR as a whole, but also in several republics and even in individual farms. For example, to insure a stable yield in the Ukraine it is necessary to locate such crops as sugar beets not only in the drought-ridden, but also in the humid zone. We know that parallel cultivation of winter, early and late spring crops raises yield stability in individual farms. In regions with alternating years of excessive and insufficient moisture parallel sowings in soils differing in their hydrophysical properties may be useful.

At present, great significance is attached to determining agroclimatic analogs to the Soviet Union on a world-wide scale. They are necessary not only to facilitate the use of foreign experience within the Soviet Union, but also for the proper planning of agricultural production within the whole Socialist sector of the world's economy, and to take into consideration the corresponding possibilities in the capitalistic sector. A map of world agroclimatic resources can be compiled with the same indices used in compiling a map of the USSR.

The climatic characteristics of a territory must be taken into account not only on the scale of the USSR, the individual republics and oblasts, but also in organizing the territory of the individual farms.

Unfortunately, in this respect we are still at the stage of working out proper methods and are taking only timid steps in applying these methods, in spite of the fact that it was in the Soviet Union, more than 20 years ago, that a detailed agroclimatic regionalization of the territory of a number of state farms in the subtropical zone was first made.

Deserving of attention among recent studies on the detailed agroclimatic regionalization of individual farms and rayons are the investigations by I. A. Gol'tsberg at the Main Geophysical Observatory, D. I. Shashko in the Yakut branch of the Academy of Sciences of the USSR, A. V. Shakhnovich and A. A. Vil'kens at the Ukrainian Hydrometeorological Institute and Yu. Y. Sudakevich at the Nikita Botanical Garden. The main, and sometimes even exclusive, attention in these studies is devoted to a detailed appraisal of the danger of frost in an area, taking into account the distribution not only of radiation frosts but also advection frosts.

Least studied is the effect of local conditions on soil moisture. At present a great deal of work is being done in compiling soil maps of individual farms. But this soil research is not coordinated with the Hydrometeorological Service, thus making it difficult to use soil maps in studying the moisture supply in the soil, for which data are assembled by the agrometeorologists of the Hydrometeorological Service. This reduces the practical value of the results of the soil research, and this defect ought to be eliminated. At the same time, the Hydrometeorological Service should also investigate the influence of local conditions, primarily soil characteristics, on soil moisture. In practice, the detailed agroclimatic regionalization of the territory of the individual farms reduces itself to determining which sections are, on the one hand, most favorable in their climatic conditions and which, on the other, are unfavorable. Depending upon the macroclimatic conditions and the requirements of the crops, various indices may be used as a basis for a detailed agroclimatic regionalization.

At present, the method that is scientifically best founded and tested in practice is the regionalization by degree of danger of frost, taking into account principally radiation freezes and frosts. Areal differentiation of the harmful effect of advection frosts, the deadliness of which is determined not only by the low temperature level, but also by the accompanying high wind velocities, is left out of consideration. This defect, which deprives us of the possibility of quantitatively characterizing, for example, the difference in frost danger between windward and leeward slopes, can be eliminated by using complex indices taking both temperature and wind into account. From this viewpoint, Bodeman's severity index deserves attention.

Detailed agroclimatic maps should aid not only in organizing the territory of farms (primarily in selecting plots for warmth-loving crops or those whose accelerated ripening under favorable microclimatic conditions is of practical significance). They will also find employment in refining and detailing weather forecasts, especially fall freezes. These maps will also be useful in working out measures for improving the climate of individual plots,

for instance, in locating windbreaks, thinning out forest stands to prevent the stagnation of cold air, etc.

In view of the practical importance of detailed agroclimatic characterizations of the territories of the individual farms, the respective organizations must combine the compilation of soil maps with a suitable appraisal of the climatic conditions. Only a joint study of soil and climate will insure the proper determination of the productivity of lands by locations, which is so needed by all farms.

It should be noted that the difference in climatic resources determined by the local characteristics of farm areas is sometimes of the same magnitude as inter-zonal differences. Therefore, the agroclimatic regionalization of individual crops even on a national scale should be corrected for the microclimate. The agroclimatic regionalization of corn in the USSR (S. A. Sapozhnikova and others, 1957) may be cited as an example of the use of such corrections.

The climate fluctuations within a century and the related fluctuations in crop yields have already been pointed out above. The investigation of the march of these fluctuations and their forecasting for the next five to ten years is of great significance. These investigations must be pushed by every possible means.

Until the laws of climate fluctuations have been established, we have to confine ourselves to distinguishing in a purely statistical way the regions with synchronous and asynchronous fluctuations, and also the limits of the possible variation of the leading agroclimatic indices (especially moisture) on the average for five to seven years, i.e., during the periods for which agricultural production is planned.

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## THE PLACE OF GEOMORPHOLOGY IN THE SYSTEM OF NATURAL SCIENCES AND ITS RELATIONSHIPS WITH INTEGRATED PHYSICAL GEOGRAPHY

By I. S. Shchukin

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In deciding the place of any scientific discipline in the whole system of sciences, the most correct approach and the one leading to the most objective solution of the problem is, it seems to us, the following: a precise and exhaustive definition of the given science at its current stage of development must be first provided, its object of study must be stated, the points of view from which that object is to be studied are to be stated, and the required methodology must be developed. From such an approach it will be evident

what sciences should underlie the given discipline and serve as its basis, and how its position in any given group of sciences is to be objectively defined. This is exactly how I would like to approach the question of the place of geomorphology in the system of natural sciences.

The most complete definition of geomorphology as a science and the one that corresponds best to the dialectical method of cognition is the following: geomorphology is concerned with the study of the relief of the earth's surface for the purpose of its practical utilization in the economic activities of man. The following objects are subject to study: (1) the external aspects of relief (sizes, forms and orientation of its elementary parts and of their natural groupings as observed in nature - relief types); (2) the origin of relief; (3) its laws of development under various environmental conditions, and (4) the spatial distribution of the elementary forms and of relief types over the earth's surface and determination of the causes of such distribution. Relief is studied as one of the components of the environment, i.e., in its interrelationships and interaction with all other components and with the natural environment as a whole. In various types of natural environment, the development of relief may take its distinctive course as determined by the entire complex and the relationships of the forces acting in each type of natural environment. The relief, as it changes in the process of development, may in turn affect the natural environment, causing its active forces to regroup and redirecting its development along new lines. This explains why the development of relief never proceeds invariably in a given direction, but always deviates to one side or another. The development of relief thus proceeds always with a forward component and takes place, so to say, in the form of a spiral, rather than in a closed cycle, as postulated by the school of William Morris Davis, the American geomorphologist, in what it regards as virtually the basic law of geomorphology.

The two most significant statements in the preceding definition of geomorphology as a science are: (1) relief is studied in its relationships with other components of the natural environment, i.e., with the geological structure, climate, surface and ground waters, soil and vegetation cover, and the animal world, and (2) relief follows distinctive courses of development in different types of natural environment. The determination of mutual relationships between components of the natural environment is one of the basic objectives and methodological foundations of physical geography, which studies the totality of types of the natural environment of the earth's surface, or the "earth's geographic envelope," as it is sometimes called. Landscape studies, a filial discipline of general physical geography, studies parts of the geographic envelope - individualized landscapes, or areal natural complexes, or, in our terminology, types of natural environment, characterized by a certain unity of structure of acting forces and processes, including the relief-forming processes. The geographic landscape is no accidental combination of phenomena in a certain part of the earth's surface; it represents a historically constituted complex of interrelated and interacting phenomena - the components of the natural environment. It is a single complex mechanism in which each component, or each "part," to use technical language, has a

certain function in the operation of the entire mechanism. If man is consciously to direct that mechanism, guiding its operation along desirable lines, or, as some say, "to operate the lever of natural processes," he must thoroughly understand the structure of that mechanism, in other words, have a clear idea of the many, not necessarily direct and therefore not easily identifiable, interrelationships among its components. Uniformity in the structure of acting forces and factors is also a criterion for the spatial delimitation and areal separation of individual landscapes, and in the knowledge of that structure we find the practical importance of the science of geography, enabling man to guide natural processes.

We noted above that identification of the mutual relationships between components of the natural environment is not always an easy task. It requires a mind trained in a certain direction and a "geographic eye," as A. A. Borzov, one of the founders of the Moscow school of geography, used to say. The geographer's eye is expected to view an object of study somewhat differently from the eye of a naturalist of more limited specialization. While the latter views the object along a single, straight line of sight going from his eye to the study object, the geographer's eye is supposed to view that object along a whole beam of diverging lines of sight going to the object through various "spheres" or "envelopes" of the earth -- the lithosphere, the hydrosphere, the atmosphere, the biosphere and, finally, the anthroposphere, i.e., the zone of man's economic activity. All these lines of sight meet at the object of study, thus reaching it along broken paths, sometimes even with several refractions in passing from one "sphere" to another. The geographer must be thoroughly familiar with the laws of such refraction to avoid seeing the object of study in an unnatural, distorted form. On the other hand, if he is thoroughly versed in these laws, his eye will see the object of study simultaneously from different directions, in various foreshortenings and aspects; he will see it, so to say, in a plastic representation.

Translating this figurative language into ordinary scientific language, we might say that a person seeking to understand a phenomenon from a geographic standpoint must approach it from various points of view, bearing in mind both its direct, simple and its complex, sometimes quite indirect, relationships with other phenomena. This also applies entirely to the relief of the earth's surface as one of the components of the natural environment. The interrelationships between these components are studied by such sciences as geomorphology, hydrology, climatology, soil science and geobotany. Each of these sciences studies only one component of natural landscapes, using the methodology of integrated physical geography, i.e., studying the component in its relationships and interaction with other components of the landscape. We are therefore justified in regarding these sciences as filial sciences of integrated physical geography. A geomorphologist trying to understand the characteristics of relief must be thoroughly grounded in such sciences as geology, meteorology, climatology, hydrology, hydrogeology, soil science and geobotany. In other words, a skilled modern geomorphologist can be trained only on a broad naturalistic, if not on a geographic plane. The

same conclusion derives from the second statement made above, namely that the development of relief proceeds along different paths in various types of natural environment. It follows that a geomorphologist must know the structure and characteristics of individual landscapes, and a geomorphologist working on the extremely diversified territory of the USSR must be familiar with the distribution of landscapes having various structures over that territory. A Soviet geomorphologist must have thorough knowledge of the physical geography of his country. That knowledge will enable him even in the preliminary period, before he goes into the field, to predict with what relief forms (and what relief origins) he will have to deal in his study area.

We can sum up the preceding statements in the following final conclusion: geomorphology is a branch of integrated physical geography concerned with the study, on a broad geographic plane, of one component of the natural environment -- its relief -- and using the methods of physical geography, and it can therefore be assigned with complete justification to the group of geographic sciences. It is quite obvious that similar conclusions can be reached with regard to climatology, hydrology and plant geography. It would hardly be worth all this discussion if the geologists did not have a tendency to assign geomorphology to the geologic sciences, completely ignoring its geographic basis. No one will dispute that geology is a major underlying discipline for geomorphology. But equally important for an understanding of relief is, for example, climatology, with its underlying discipline -- meteorology. It is not without reason that West Europeans now distinguish structural and climatic geomorphology. We would not accept such a breakdown because relief is always the result of the combined and simultaneous action on the earth's surface of both endogenous factors (tectonics, movements of the earth's crust) and exogenous factors. Even in those cases where a given relief form is due entirely to the action of external forces, the conditions for the creation of those forces have usually been created by appropriate movements of the earth's crust. At the same time the appearance of exogenous relief-forming forces and their distribution over the earth's surface depend almost entirely on climate. Suffice it to mention such climatically caused processes as the character and intensity of weathering of rocks, the role of the wind in the formation of desert relief and in reshaping the shorelines of natural and artificial water bodies, and so forth. If we consider for a moment the masses of rocks that were altered and removed as a result of the action of exogenous factors, then their role in the transformation of the relief of the earth's surface will surely not be considered less than the role of tectonic factors. However climatologists and meteorologists never claimed geomorphology as their discipline on the ground that climate and the physical processes of the atmosphere are a major factor of relief formation. The geologists' claim to geomorphology as a purely geological science therefore appears to us quite unjustified. In addition it should be noted that geomorphology at the present time, at least in the Soviet Union, is not called upon to solve problems merely of a geological character: it now enters into the work of all segments of the national economy, including even those that are primarily concerned with phenomena related to the work of exogenous agents, but requiring a broad geographic approach to an appraisal of the role of such agents.

The geologists' claims to geomorphology as a geological science are evidently inherited from the past, from that initial stage in the development of geomorphology when it first took form and was used by American investigators of the Far West in the second half of the 19th century merely as an auxiliary method in geology to determine the geological structure more speedily on the basis of its reflected surface forms. But that "structural" geomorphology represents a one-side approach to the study of relief. That stage has been long passed. Since then geomorphology, despite its relative youthfulness, has advanced over a rather long course of development and has outgrown its initial geological orientation. However the one-sided approach to geomorphology continues to be evident among geologists. I would like to mention one characteristic episode. In 1939 I. P. Gerasimov and K. K. Markov published their Chetvertichnaya geologiya (Quaternary Geology) (incidentally, an unhappy title, which should have been changed to Paleogeografiya chetvertichnogo perioda -- Paleogeography of the Quaternary Period). That book had a rather hostile reception among Soviet geologists. Why? Apparently because in any discussion of Quaternary glaciation one criterion was the be-all and end-all for geologists, and that was stratigraphy. The authors of the book, as geographers, approached Pleistocene glaciation from a broader viewpoint, though without ignoring stratigraphy, and reached a number of entirely new and very interesting conclusions. The authors started, for example, from the premise that climatic differences over the huge territory of Eurasia must have affected the character of glaciation in various parts of the continent. Glaciation must have developed, and disappeared, at non-uniform rates: glaciation reached its maximum at different times and its character differed in areas of oceanic and continental climate. Hence the authors reached conclusions regarding the non-simultaneous (metachronistic) character of the glaciations, areal differences in the number of glaciations, and so forth. Their findings, in particular, disproved the justification for applying to the lowlands of Northern Europe the Alpine scheme of four glaciation stages and its terminology (Günz, Mindel, Riss, Wurm), which had been championed by some geologists.

The one-sided approach to problems of Quaternary glaciation, based simply on stratigraphy or simply on the study of Qua ternary fauna, continues to be in evidence. Only by such a one-sided approach can we explain the fact that some geologists (S. A. Yakovlev, A. I. Moskvitin) identify six or even seven separate glaciation stages in the Russian Plain, while others (V. I. Gromov) find only one stage. K. K. Markov has given us a very convincing criterion for determining the number of glaciation stages and for differentiating between interglacial stages and short-lived or insignificant retreats of the edge of the ice sheet, which he calls "stadial" retreats. That criterion is Qua ternary fossil flora, which is the best indicator of past climatic conditions. The criterion is used as follows: If sediments separating two layers of moraine contain remains of flora that was more warmth-loving than the flora associated with the given point at the present time, the indication is that the climate of that period was milder and glaciation could not have exceeded its present magnitude, i.e., it was a real inter-glacial stage. On the other hand, the presence of more

cold-resistant flora than at present indicates the proximity of the ice sheet and can be taken as evidence of an insignificant or short-lived retreat. Using that criterion, most geographers, and particularly geomorphologists, now identify three glaciation stages in the Russian Plain.

I like to touch on one more question relating to geomorphology, and that is its interrelationships with so-called broad geography. Several articles have appeared in the Soviet geographical literature in recent years, directed against the separate disciplines of physical geography -- geomorphology, climatology, hydrology, biogeography.

The breakdown of a broad scientific discipline into narrower, filial disciplines in the course of its development is an entirely normal and legitimate process for every developing phenomenon. As more data are accumulated and subjected to theoretical generalization, new problems inevitably arise in every science, leading scientific thought further and deeper in highly diversified and often unexpected directions. That process must be associated with the deepening, improvement and increased specialization of study methods using the data of other sciences, which may often be quite distant from the borrowing discipline. In the end this leads to the point where one person is unable to master all these methods and must concentrate on a few limited objectives. It is, however, important, that he does not lose touch with the basic methodology of the mother science.

Each science uses two basic, equally important and for the most part almost inseparable methods of scientific cognition: scientific analysis and scientific synthesis. Earlier we gave a definition of the concept of "geographic landscape" and noted that the basic task of geographic study was to establish its structure, i.e., to determine the interrelationships among its components. Without a determination of these relationships, so-called integrated (or broad) geography would become simply a descriptive science, deprived of all cognitive importance, i.e., it would cease to be a real science. But in order to accomplish their task (the determination of interrelationships) regional geographers and landscape students must shift from synthesis to analysis. Some broadly trained geographers try to accomplish that task independently, which is only to be welcomed. But unfortunately they often disclose their weak side: the large number and diversification of phenomena with which they must deal make it impossible for them to carry their research to sufficient depth, and their conclusions are therefore often superficial. More cautious geographers prefer in their research to use data on relationships borrowed from the specialized disciplines of physical geography -- geomorphology, climatology, hydrology, biogeography. These sciences are concerned primarily with the analytic side of geographic research, and the narrower circle of phenomena that fall within their competence enabling them to carry out their analysis with greater depth.

The foregoing comments are especially important for Soviet science, in which the dialectical approach to study phenomena is the basic method of

research. The dialectical method requires that phenomena not be studied in isolation, outside of their relations with other phenomena. If a geomorphologist studies the relief of a given area, he cannot ignore the effect on the character of the relief, its origins and its laws of development of such factors as the geological structure of the area, its climate, the elements of hydrography, the plant cover, man's economic activities, and so forth. Unfortunately the relationship between these factors and relief is often treated in a one-sided manner in the specialized disciplines. The geomorphologist does not ask himself how relief, in turn, affects climate, surface and ground waters and the plant cover. These questions are certainly not irrelevant for an understanding of relief characteristics, as was shown above in the definition of geomorphology as a science.

This methodological inadequacy of the specialized physical-geographic sciences -- the determination of only one-sided relationships and effects -- is partly compensated by the fact that other specialized sciences deal with the reverse relationships. For example, a climatologist seeking to understand the climatic characteristics of an area, must take account of the role of the underlying surface as a basic factor of climate formation. But the climate-forming role of the underlying surface is determined by several factors -- its relief, its vegetation cover, the character of its surface formations, the magnitude of the earth's albedo, and so forth. The effect on the climate of each of these factors must be considered individually, and the effect of the relief should be considered first.

Just as integrated geographers (landscape geographers, regional geographers) must sometimes shift from synthesis to analysis, specialized physical geographers who use primarily analytic methods must sometimes also resort to synthesis. For example, a geomorphologist trying to determine the history of development of the relief of a given area is often forced to reconstruct the natural environment of the past to explain the presence of certain relief elements that are not related to present-day natural conditions and are therefore relics of the past.

In view of the foregoing, we cannot understand why some broadly trained geographers regard synthesis as a superior method of scientific research, and consider analysis, used mainly by specialized physical geographers, as some sort of "ditchdigging". No one regards the analytical chemist as anything but a chemist, while the analytical geographer, it seems, does not even deserve the name of geographer, as N. N. Baranskiy once said.

It has also been stated that narrow specialization in geography teaching at the university level supposedly duplicates specialists in the same fields at specialized institutions and schools. Actually narrow geographic specializations at the geography faculties of universities do not duplicate anything. Specialized geomorphologists are still being trained only at geography faculties and the idea of duplication is entirely out of the question. Geographer-climatologists are also being trained only in universities because the present hydrometeorological institutes train only physicists of the atmosphere

- meteorologists and synopticians. Climatology is a purely geographical science because every climate is closely associated with a certain segment of the earth's surface, because it reflects all the physical-geographic characteristics of that segment and because it is not repeated exactly anywhere else. Every agronomist must be familiar with such a "local climate" for the proper organization of agricultural production and the use of the appropriate cultivation practices. For example, in irrigated areas the local climate determines the amount of irrigation water needed since, according to A. I. Voyeykov, excessive moisture may be just as harmful as insufficient moisture, retarding the maturation of cotton, for example. If the university-trained geographer-climatologist still has not obtained full recognition in Soviet economic life, we have no doubt that it is only a question of time and that life itself will demonstrate the need for such a specialist.

The training of a geographer-hydrologist is also quite different from that of a hydraulic engineer. In contrast to the latter, the hydrologist does not study water in motion and in a state of equilibrium, but natural water bodies – rivers and lakes (as well as ice) – in their natural surroundings. The natural conditions of their basins, which can be changed by man, in turn determine the total water resources, the sources of supply, the seasonal regime, the chemical composition of the water, the nature of plant and animal life, the character of stream sediments, and so forth. Data on all these characteristics must be obtained for the proper management of these water bodies, which are becoming of increasing importance in the Soviet Union.

Where then does the fault lie with the specialized disciplines of physical geography? That question is answered by Prof. V. N. Sementovskiy("The Training of the Physical Geographer," Voprosy geografii, No. 25, 1951). He sees the main defect in the fact that "through these specialized disciplines persons are included in geography who received their training at other university faculties and actually never thought of working in geography faculties." As an example, the author cites the following "genetic series": physics - geophysics - physics of the atmosphere (meteorology) - synoptic meteorology - climatology. It seems to us that for talented persons endowed with a broad outlook such an evolution is quite possible, as demonstrated by many examples. That was the course followed by A. I. Voyeykov, whom we consider one of the leaders of Russian geography. V. V. Dokuchayev also rose to broad, truly geographic generalizations from a non-geographic field – geology. D. N. Anuchin started his career as a geographer from zoology, A. N. Krasnov from botany, S. L. Berg from zoology. Many other examples could be cited. On the other hand, a mass production of broadly trained geographers able to operate the "levers of natural processes" does not always succeed. The time of the Humboldts is obviously past. Experience shows many persons, having received such broad geographic training and being left to their own resources, still become narrow specialists and shut themselves off from everything else. "To stand at the helm of natural processes" is evidently not such a simple matter and even the integrated geographers do not have much confidence in their own knowledge and ability in that respect. And not without justification! After all, clumsy interference in the processes of

nature can sometimes produce reactions that may be quite undesirable and harmful from man's point of view.

Coming back to Sementovskiy's views, it should be noted that the introduction into geography of representatives of other sciences is quite in accordance with the general tendency of present scientific development. The boundaries between sciences, once sharply marked, are being gradually wiped out. New branches of science begin to emerge along the border lines of earlier sciences. And many of these new sciences appear to be full of promise. Sementovskiy was wrong when he said in 1951 that "there is not and there cannot be any chemical geography." Now it exists under the name of "landscape geochemistry" and has been included in the curriculum of broadly trained geographers.

It seems to us that by attacking the specialized geographic disciplines on which "broad geography" should be relying to a greater extent, integrated geographers are like persons who are cutting off the branch on which they are sitting.

I would be greatly chagrined if my article were taken as an attack against broadly integrated geography. This would be especially unfair because I do not consider myself a representative of narrowly specialized geomorphology. I think that broadly integrated geography (regional geography, landscape studies) has just as much a right to exist as the specialized disciplines of physical geography, and that in the end it will take its proper place in the general culture and economy of the Soviet Union. But that requires closer contact with the specialized branches, from which integrated geography can borrow a great deal needed for synthesis.

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## THE STUDY OF A SYSTEM OF CITIES OF THE SOVIET UNION

By Yu. G. Saushkin

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Soviet economic geographers have accomplished a great deal to solve the important theoretical and practical problem of the network and typology of cities. We should cite especially the studies of N. N. Baranskiy (1), O. A. Konstantinov (4), V. G. Davidovich (2), E. V. Knobel'sdorf (3), A. A. Mints and B. S. Khorev (5) and L. L. Trube (7). These authors devoted most of their attention to the origin of cities, their economic-geographic location, their economic functions and some other characteristics. In the work of Soviet urban geographers, the study of cities has started to acquire an importance all of its own. However, we should not rest on our laurels, but look for shortcomings in existing studies and, looking ahead, outline new approaches to the economic-geographic study of cities.

The shortcomings of existing studies lie in the fact that, on the one hand, they have started to acquire a self-contained "academic" importance and to become divorced from the tasks and methods of economic geography and, on the other hand, have started to gravitate toward architectural planning studies. This incidentally explains their poor reception among architectural planners who need neither duplications of their own work nor abstract academic schemes, but expect economic geographers to provide a completely new and fresh approach to the study of cities.

From the descriptions of individual cities or the cities of individual regions, we must now proceed to create an economic-geographic system of cities of the Soviet Union. Without such a system, geographic city studies would reach a dead end and lose their importance.

The unity of geographic city studies and economic geography lies in the fact that a system of cities can be established on a scientific basis only in close connection with a system of territorial division of labor within a country and, more broadly, an international division of labor.

A network of cities arises over a long period of time, while a transportation net and especially a system of territorial division of labor change far more rapidly. The question may arise whether the network of cities, being more stable over time and being constituted of stone and concrete, can be compared with a rapidly changing system of territorial division of labor. But the point is that the present article does not deal with a network of cities, which has been rather thoroughly studied by Soviet economic geographers, but with an economic-geographic system of cities. A network of cities, taken by itself at any point in time, can be regarded from various points of view: historical (the history of formation of the network of cities), geographical (the distribution of the network of cities), demographic (the composition of the population), architectural planning (the construction of cities), engineering, and so forth. A system of cities, on the other hand, as treated in this article, is the system of their dynamic interrelationships created at a given stage of development of the territorial division of labor. In a system of cities each city is regarded as a major or minor node in the system of the division of labor among countries and economic regions. In contrast to the network of cities, the system of cities is studied by one discipline only, and that is economic geography, the science dealing with territorial combinations (complexes, structure, organization) of productive forces arising in the process of economic development of the geographic environment and the development of a territorial division of labor. Economic geography is quite self-sufficient in studying a system of cities; it does not duplicate the work done by other disciplines and is able to establish scientific laws of considerable theoretical and practical importance.

Previous Principles of Typology of Cities of the Soviet Union. In summarizing the activities of the Commission on Population and Cities of the Moscow Branch of the Geographical Society USSR, B. S. Khorev

provided in Voprosy geografii (8) a concise and useful statement on the typology of cities of the Soviet Union. One-sided classifications have turned out to be devoid of all vitality. The principal criteria for classifying cities now are functional criteria based on the significance of the city and the occupations of the population in various types of production . These criteria may be combined with others, such as the economic-geographic location of the city, transportation facilities, size of the population, origins, and so forth.

As a recent example of such a functional classification of cities of the Soviet Union, we might cite the typological scheme for cities of the Central Industrial Region proposed by A. A. Mints and B. S. Khorev (5): capital cities; large economic, administrative-political and cultural centers — "complex" cities; diversified industrial centers with a specialization in two or more branches of industry (cities of heavy industry, cities of light industry, cities of mixed industry); cities with one specialized industry; cities with predominantly nonindustrial functions (a. organizing centers of farming and lumbering areas; b. cities with pronounced transportation functions; c. other nonindustrial cities); suburban cities.

On that functional classification Mints and Khorev superimpose a genetic classification: old cities in which the pre-revolutionary production structure has remained virtually unchanged; old cities that have acquired new functions and new industrial specializations; old cities whose pre-revolutionary production structure has been thoroughly transformed; new cities that have arisen on the site of factory villages and suburban villages; new cities that have arisen on the site of commercial and industrial villagesor "handicraft" villages; new cities that have arisen on an empty site or on the site of farm settlements. According to Mints and Khorev, the "intersection" of functional and genetic criteria produces a "combined" city type, which they regard as a realistic typological characterization of a city.

Such an approach is logical. This method has now superseded the old classifications. But even this typological scheme does not fully meet the requirements of Soviet economic geography because the approach is essentially cognitive in character and has little scientific and practical importance.

Current typological schemes used in the classification of cities of the Soviet Union do not reflect the tremendous importance of cities as the "framework" of the nation's economy or its "focal points", to use N. N. Baranskiy's expression. Furthermore these schemes are largely speculative and devoid of a quantitantive basis, which greatly reduces their scientific and practical applicability.

Principles of Typology of Cities Based on Their Role in the Territorial Division of Labor. A system of cities and of transportation routes is the basis of the present-day territorial division of labor. Some cities are situated near mineral and fuel sites and play a part in mining, concentration and transportation; other cities collect farm products from the surrounding

area and transport and process these products; still other cities produce and transmit a huge amount of electric power, some cities convert raw materials into semi-manufactured goods, other cities use electric power, semi-finished goods, fuel and sometimes raw materials to make labor-consuming manufactured goods, and so forth. Each city has its place in the labor cycle - from mining of the raw mineral or fuel to the manufacture of complex and precision items. Each city is a link in the chain of the territorial division of labor.

A typology of cities based on their role in the territorial division of labor must take account of the scale of the division of labor: within a basic economic (major economic-geographic) region (6), within the Soviet Union or an international division of labor. The typology of cities is thus closely related to the problem of a correct economic regionalization of the country, reflecting the actual territorial combinations of productive forces and the actual division of labor.

Looking at the system of cities of the Soviet Union as a "framework" of the system of territorial division of labor, we can propose the following principles for a typology of cities, based on various forms of transition from the production of raw minerals, fuels and electric power to their processing and transportation and the consumption of semi-finished and finished goods. Cities (and city-type settlements) can be divided into three groups according to their role in territorial divisions of labor at various scales: (a) cities participating in the intra-regional division of labor; (b) cities playing a major role in the inter-regional division of labor; (c) cities in which links with the world market are of equal or greater importance than those with the domestic market. Cities (and city-type settlements) then form the following system:

I. Raw material, fuel and power group.

1. Cities situated at operating fuel sites and specializing in the mining, enrichment and transportation of fuel.
2. Cities situated at operating ore sites and specializing in the mining, concentration and transportation of ores.
3. Cities situated at operating nonmetallic mineral sites and specializing in their mining, concentration, partial processing and transportation.
4. Cities situated at operating sites of rare and precious metals and minerals and specializing in their mining, concentration and transportation.
5. Cities specializing in the production of electric power based on local power sources.
6. Cities collecting local farm products and engaged in their primary processing and transportation.
7. Cities collecting local timber and engaged in its partial rough processing and transportation.
8. Cities collecting products of marine, lake or river origin and engaged in their primary processing and transportation.
9. Other cities related to the production and transportation of raw materials.

II. Group of intermediate production stages.

10. Cities using large amounts of raw materials and fuel and specializing in the production of metals and basic chemicals and in the transportation of such products.
11. Cities specializing in the production of semi-finished goods, parts and auxiliary materials for metal-fabricating centers that produce finished goods.
12. Cities specializing in the production of semi-finished goods of light industry.
13. Cities specializing in the production of semi-finished goods of the woodworking industry.
14. Other cities with intermediate production stages.

III. Group of finished industrial production.

15. Cities combining the mining of fuel (ores or nonmetallics) and metallurgy (or basic chemicals) with the processing of raw materials and semi-finished goods into finished goods.
16. Cities with a narrow specialization in the finishing stage of heavy manufacturing industry based on outside raw materials and fuels.
17. Cities with a broad specialization in the finishing stage of heavy manufacturing industry based on outside raw materials and fuels.
18. Cities combining all processing stages, from raw materials or semi-finished goods to finished goods, in the woodworking industry.
19. Cities combining all processing stages, from raw materials or semi-finished goods to finished goods, in the food and light industries.
20. Cities with a specialization in woodworking, food and light industries, producing finished goods from outside raw materials.
21. Cities with a broad industrial specialization, producing finished goods from outside raw materials and fuels.
22. Other cities with finished industrial production.

IV. Group of transportation cities.

23. Cities that are transportation nodes (railroad, river, maritime, trucking) specializing in the transshipment of goods, with repair industries and incidental production of means of transportation and warehouse equipment, and with warehouses, grain elevators, cold-storage plants and oil-storage areas.
24. Other transportation cities.

V. Group of nonproductive cities.

25. Nonproductive residential cities (in suburbs of large centers).
26. Resort cities with local service industries.
27. Administrative-political centers with service industries.
28. Cultural centers with local service industries.
29. Other nonproductive cities.

The proposed typological scheme of the system of cities of the Soviet Union, based on the cities' role in the territorial division of labor, is submitted as a working hypothesis. The scheme, of course, requires practical verification, improvement, corrections and additions. It does not exclude other typological schemes based on historical, statistical-economic or architectural-planning criteria. But as far as economic geography is concerned, it is time for it to stop borrowing typological schemes from other disciplines and to create its own scheme.

Indices in the economic-geographic typology of cities. The proposed system for an economic-geographic characterization of cities of the Soviet Union must be based on several quantitative indices.

The system of industrial , agricultural, transportation and demographic statistics has been rather well worked out, but the city as a whole has not yet become the object of statistical accounting. As a result the economic planning of the Soviet Union and its regions suffers. The lack of "city" statistics makes it difficult to apply quantitative indices to the typology of cities, but these difficulties can be overcome, especially by research institutes connected with the problem of city construction and the problem of territorial division of labor (complex transportation problems).

The following comparable relative indices should be applied to the typology of cities and the compilation of economic maps of the system of cities:

1. The relationship (in weight) between outgoing to incoming goods (excluding transit). In cities of types I-1, I-2, I - 3 etc., outgoing freight will greatly exceed incoming freight; in cities of types II-10, incoming freight will be much greater than outgoing freight; in cities of type III-20, outgoing freight will be quite insignificant compared with outgoing movements.

2. The relationship (in value) between outgoing to incoming goods (without transit). In most cases the value of outbound goods exceeds the value of inbound goods, the ratio increasing with the degree of processing done by the city. In cities of types IV and V, the situation is reversed.

3. The ratio of the value of goods shipped from the city to the value of goods produced in the city. This index of the degree of the city's "marketability" measures the intensity of its participation in the territorial division of labor.

4. The per capita value of outgoing goods. This index supplements the preceding index and also measures the intensity of the city's participation in the territorial division of labor.

5. Transportation freight turnover (inbound and outbound) per capita. This index to a certain degree measures the exchange of goods between the city and the region, which is important for typing the city.

6. The ratio of electric power production in the city to its electric power consumption. This index includes the city in a special sphere of the territorial division of labor - the sphere of production and transmission of electrical energy. This index applies especially to type I-5 and least to the cities of type III.

7. The relationship between three destinations of the city's outgoing production (in per cent of the total value): within the basic economic region, outside the region but inside the country, outside the country. This is an index of the scale of the city's participation in the territorial division of labor.

8. The relationship between three types of outgoing production (in per cent of the total value): raw materials and fuels, intermediate types of products (semi-finished goods, parts) and finished goods. These relationships make it possible to assign cities to groups I, II or III.

9. Finally, an analysis of the structure of freight turnover—the relationship between incoming and outgoing goods in value compared with the structure of the population and the structure of the city's industrial production—makes it possible to determine the city's specialization, its narrowness or breadth and its qualitative characteristics.

The scientific and practical significance of a study of the system of cities of the USSR. One of the main economic objectives of the Soviet Union is to insure a rational geographical distribution of productive forces, especially industry, to insure the highest possible productivity of labor.

In April 1918, Lenin clearly stated the policy to be followed in the rational distribution of industry of Soviet Russia, which was supposed to be based "on the proximity of raw materials and the possibility of expending the least amount of labor in the transition from the processing of raw materials to all subsequent stages of the processing of semi-finished and finally to the output of finished goods" (V. I. Lenin, Soch. (Collected Works), Vol. 27, p. 288). That statement has been often cited in the economic-geographical literature. However Soviet economic geographers have not been sufficiently concerned with an analysis of the degree to which Soviet industry has been brought closer to bases of raw materials, fuels and other sources of energy, and how great the distances and labor expenditures are in the transition from the processing of raw materials to semi-finished and finished goods. Strangely enough, questions of rational utilization of natural resources, the territorial division of labor, productive links between economic regions and cities, links between regions (and centers) of production and regions (and centers) of consumption have been rather neglected in the Soviet literature.

The proposed scheme for a study of the system of cities of the Soviet Union based on their role in the system of territorial division of labor is designed to point up those transitions from the processing of raw materials

to the output of finished goods about which Lenin wrote more than 40 years ago—transitions of raw materials, fuels, semi-finished goods, parts and other intermediate products from one city to another, and finally to the cities producing the finished goods.

Without knowing the nature of these transitions from raw material to finished product among the cities of the Soviet Union, we cannot speak about a scientifically founded, long-term, geographical distribution of industry. That is why the typology of cities based on their role in the system of the territorial division of labor is of great scientific and practical importance.

The indices listed above make it possible to measure the degree of intensity of the city's participation in the division of labor and the level that the city occupies in that division. Use of the comparative method makes it possible to identify cities that are making rapid advances and cities that are lagging behind. An examination of the types of cities by major economic regions from the point of view of the scale and intensity of participation in the division of labor makes it possible to reappraise the trends in the development of the regional economies.

The proposed scheme does not take account of the historical past of cities (old fortress cities, old commercial cities and so forth), but that does not mean that the scheme is non-historical. It does reflect contemporary history and to a certain extent the future of the cities.

Our next objective should be the compilation of an economic map of the present-day system of cities of the Soviet Union. It would be interesting to compare it with maps compiled for some past years. Such a comparison would provide a clear picture of changes in the system of territorial division of labor in the Soviet Union. The planners would thus receive an excellent tool for the long-term geographical distribution of productive forces.

This article has stated the problem of study of the system of cities of the USSR as a first approximation. A great deal of work will be required from Soviet economic geographers to pose this problem in its entire breadth and to accumulate factual data for its concrete solution. The work will apparently start with a study of the system of cities in individual republics (Ukraine, Kazakhstan) and individual regions, to be followed by the development of a system of cities for the Soviet Union as a whole.

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## PARTICIPATION OF MOSCOW UNIVERSITY GEOGRAPHERS IN PRACTICAL WORK OF REGIONAL ECONOMIC COUNCILS

By A. S. Shaposhnikov

(From Vestnik Moskovskogo Universiteta, seriya geografiya, 1960, No. 1, Pages 32 - 42).

The June 1959 plenum of the Communist party's Central Committee said that one of the serious shortcomings in the activities of research institutions and universities was their weak links with production. The plenum also noted that these institutions did few major studies under contract with regional economic councils, industrial plants and construction projects. In that connection the plenum adopted a resolution "recommending the expansion of research work done under contract with regional economic councils, industrial plants and construction projects" and instructed Gosplan USSR together with the Ministry of Finance USSR, the Academy of Sciences USSR, the State Science and Technology Committee USSR and the Ministry of Higher and Secondary Specialized Education USSR to work out procedures for financing contractual research, for which regional economic councils, industrial plants and construction projects would be authorized to draw the necessary funds from budgetary allocations.

The June 1959 resolution opens great possibilities for the expansion of research activities that can be of direct use to Socialist construction. The regional economic councils dispose of ample funds for such research and are prepared to transfer these funds to research institutions and universities for research work under contract.

The research needs of regional economic councils are still being far from satisfied. Research institutions and universities are still unable to meet all the research requests of the councils. The councils are therefore setting up their own research institutions and are organizing their own laboratories at some of the larger universities.

For two years now the Volga Field Group has been in existence under the Geography Faculty of Moscow University. The group was set up at the end of 1957 on the basis of the Tatar-Bashkir group, which had been engaged

in economic-geographic research on the construction industry and its raw-material base in the Tatar and Bashkir economic administrative regions under contract with the Construction Economics Research Institute of the Academy of Construction and Architecture USSR. (Economic administrative regions coincide with ASSR's and oblasts in the RSFSR - Editor, S. G.)

The Volga Field Group has been doing research on the following four topics:

1. The distribution and development of the construction industry and the building materials industry and their raw-material base in the Kuybyshev economic administrative region (project director -- Senior Staff Member A. S. Shaposhnikov).
2. The economic geography of the industry of the Kuybyshev economic administrative region (project director -- Prof. Yu. G. Saushkin).
3. The distribution and development of the construction industry and the building-materials industry of the Ul'yanovsk economic administrative region (project director -- A. S. Shaposhnikov).
4. Field investigation and drafting of a technical and economic plan for the group of new cities in the area of the Kuybyshev Hydroelectric Station (project director -- Docent N. Ya. Koval'skaya).

The first two projects are under contract with the Kuybyshev regional economic council and the third with the Ul'yanovsk council. The councils gave the Geography Faculty the maximum limits for the expenditure of special funds, for salaries and for personnel. The fourth topic is financed by the Institute of City Construction and Rayon Planning of the Academy of Construction and Architecture USSR.

On the first topic, a report has already been submitted to the regional council, which decided to publish it in 1960. It contains an economic-geographic treatment of the construction organizations and the building-materials industry and its raw-material base in Kuybyshev economic-administrative region. The report includes 22 maps, including 18 large-scale maps. It is designed to be of direct assistance to personnel in the building-materials industry. The report contains maps and catalogues of mineral building-material sites in Kuybyshev Oblast as a whole and in the vicinity of major construction projects. The catalogues and maps indicate the types of raw materials, the quantities and the fields of application in construction, with a breakdown of reserves into proven and probable. The catalogues in addition give data on quality (chemical and mechanical analyses), the mining geology of the deposits (age, area, thickness of deposit and thickness of overburden), the mining conditions of the deposits, transportation facilities and reference sources. These catalogues and maps save construction workers and employees in the building-materials industry from having to go through numerous and often quite bulky geological reports and other source materials on building-materials deposits. The catalogues and maps provide ready information on the distribution of deposits and the quality and quantity of the building materials. As for the bulky geological reports, they have to be consulted only for deposits that turn out to be especially important for the location of new building-materials industries.

The catalogues and maps thus greatly reduce the cost involved in the establishment of new construction projects and building-materials industries. They are already in great demand on the part of various departments of the regional economic council, construction trusts, building-materials factories and project-design institutes.

In addition to the catalogues and maps of deposits, the report includes lists and major production-economic indices of the work of construction organizations and building-materials factories, as well as maps of these organizations and factories. These maps cover both Kuybyshev Oblast as a whole and its six major construction areas. The maps provide a ready picture of the distribution of construction organizations and their administrative jurisdiction, which is still quite complex. The maps enable the regional economic council and other institutions to insure a more rational distribution of construction organizations in major construction areas and in Kuybyshev Oblast as a whole, and to reduce the multiplicity of jurisdictional ties.

The maps of building-materials enterprises show factories and individual building-materials sites, with their annual production capacity. These maps facilitate the problem of distribution and organizational reform of the building-materials industry and the reduction of the multi-jurisdictional network of building-materials enterprises. The field group discovered some disproportions in the development of the construction industry and the building-materials industry and gave the Kuybyshev regional economic council appropriate recommendations. Work on this study project was done in cooperation with the Orgenergostroy Institute in Kuybyshev. On the basis of the field group's findings, the institute is working out a long-range plan for the development of the construction industry and the building-materials industry of the Kuybyshev economic administrative region.

The study project on the economic geography of industry in the Kuybyshev economic administrative region is to run three years and is expected to be completed in December 1961. The aim of the project is to investigate the present status of the industrial complex and the territorial organization of industry of the Kuybyshev economic administrative region (distribution of industry, conditions for development, industrial structure, raw-material and energy supply, internal and external production links).

Attention will be concentrated on an analysis of the distribution, combining, specialization and subcontracting of industry in the region as a whole and in the various industrial nodes. Industrial manpower and the most important industrial cities and settlements will also be studied.

The final report is to be drawn up with the help of administrative employees of Kuybyshev Oblast. It is to be followed by a monograph devoted to the economic geography of industry of Kuybyshev economic administrative region, offering conclusions on the rational distribution and the role of the major nodes in the territorial production complex of the region. The project is being carried out in cooperation with the Kuybyshev Planning

Institute, which on the basis of the field group's findings and its own studies will work out rayon plans for the major industrial nodes.

The field group will not limit itself to the industry of Kuybyshev Oblast. It plans to study the industry of the entire Middle Volga region, and then of the Volga Region as a whole, solving at the same time certain problems relating to economic regionalization in these areas. On the basis of its findings the field group will undoubtedly have suggestions regarding the change of boundaries between certain economic administrative regions in the Middle Volga. For example, it may pose the question of attaching the western part of Orenburg Oblast to Kuybyshev Oblast and thus to the Middle Volga economic region. That part of Orenburg Oblast is closely linked with the Kuybyshev economic administrative region.

There are very close production links between the petroleum fields of Orenburg Oblast and the eastern part of Kuybyshev Oblast. The oil fields of Orenburg Oblast and eastern Kuybyshev Oblast actually form a single oil district identified by the production centers of Otradnyy-Pokhvistnevo-Buguruslan (or Kinel'-Cherkassy--Buguruslan). The Buguruslan oil-field administration operates oil wells situated not only in Orenburg Oblast but also partly in Kuybyshev Oblast (for example, the Klinovka-Zhuravlevka-Stepanovka deposit). On the other hand, the Kinel' oil-field administration of the Kuybyshev economic council, situated in Kuybyshev Oblast, operates the Gorodets field in Orenburg Oblast and is planning to operate the Zhukovka deposit, which is also situated partly in Orenburg Oblast. Finally, the Baytugan deposit, situated only in Kuybyshev Oblast, is being operated by the No. 2 field of the Buguruslan oil-field administration of the Orenburg economic council.

The oil and gas fields of the eastern part of Kuybyshev Oblast adjoining the Buguruslan oil district of Orenburg Oblast are being supplied with electric power from the Buguruslan power station, which transmits almost half of its output to the Kinel' oil-field administration of Kuybyshev Oblast. On the other hand, the No. 1 gas field of the Kinel' administration, situated near Pokhvistnevo (Kuybyshev Oblast), transmits part of its output through a compressor station to the city of Buguruslan (Orenburg Oblast).

The Otradnyy-Pokhvistnevo (Kinel'-Cherkassy) and Buguruslan areas also form a single oil-field zone from the point of view of transportation. Both areas are traversed by the Kuybyshev-Ufa railroad, which is the main transportation artery of the Otradnyy-Pokhvistnevo-Buguruslan oil district. The parallel Kuybyshev-Abdulino highway is also a major transportation artery of the oil areas of Orenburg and eastern Kuybyshev oblasts. The crude-oil pipeline from Bavly (Tatar ASSR) to Kuybyshev, passing through Orenburg Oblast, serves both Orenburg and eastern Kuybyshev oblasts, tying them into a single Otradnyy-Pokhvistnevo-Buguruslan (or Kinel'-Cherkassy--Buguruslan) oil district.

The Buguruslan oil area of Orenburg Oblast and the Otradnyy-Pokhvistnevo (or Kinel'-Chekassy) oil area of Kuybyshev Oblast also have much in common from the point of view of industrial development. In both areas oil production

is the main industry, and other activities are either incidental or related service industries.

The two areas are also joined by their population characteristics and manpower resources: in both areas the population is employed to the same extent in the oil industry and the ethnic make-up is the same. The same is true of the structure of agriculture, with the only difference that the emphasis on grain production and sheep raising is greater in Orenburg Oblast than in Kuybyshev Oblast.

The combined oil district includes the following rayons: In Orenburg Oblast -- Buguruslan, Aksakovskiy(rayon seat: Sovetskoye), Asekeyevo, Grachevka, Krasnopartizanskiy (rayon seat: Troitskoye), Matveyevka, Ponomarevka, and Derzhavino (Aksakovskiy Rayon was merged with Buguruslan Rayon, and Derzhavino Rayon was merged with Buzuluk Rayon in April 1959 -- Editor, S. G.), and in Kuybyshev Oblast -- Kuybyshevskiy (rayon seat: Krotovka), Pokhvistnevo, Isakly, Podbel'skaya, Petrovka and Kinel'-Cherkassy. The rayons now in Orenburg Oblast should be incorporated into Kuybyshev Oblast. This would result in a more rational,economical and effective administration of the oil and gas industry. The administration of the Buguruslan oil fields from the Orenburg economic council is quite non-rational. It should be borne in mind, in this connection, that Orenburg Oblast has no oil areas other than the one around Buguruslan.

These oil fields should be administered from the Kuybyshev economic council, which has a special oil administration and several oil institutes with a large body of trained specialists (the Giprovostokneft' institute for oil-industry project designs in the eastern part of the country, the Scientific Research Institute of the Oil Industry, and so forth). The Kuybyshev economic council administers not only a large crude-oil and natural-gas industry, but also oil refining and petrochemicals, which have been quite highly developed in the Kuybyshev economic administrative region. It should be remembered that the boundary between Kuybyshev and Orenburg oblasts was drawn long before there was any oil industry in this area and that the boundary has become outdated. The preliminary ideas of the field group on that question have already been submitted to the Economics Committee of the Soviet of Nationalities of the Supreme Soviet USSR. Additional detailed data will be supplied later.

The field group is made up of personnel from the Departments of Economic Geography of the USSR, Geodesy and Cartography, and Geomorphology. Cartographic work of the field group is being directed by the assistant director of the field group for cartography, Senior Staff Member Ye. E. Tsedeler.

It is pleasant to realize that the work of the geography field group will be of benefit to Socialist construction. At the same time, such work, by drawing academic geographers into the field, enriches geography with new, very up-to-date materials for further scientific generalization.

# AGRICULTURAL MAPS IN NATIONAL ATLASES

By N. S. Vinogradova

(From Vestnik Moskovskogo Universiteta, seriya geografiya, 1960, No. 1, Pages 43 - 48).

Agricultural maps occupy an important place in national atlases. In some atlases (France, Italy, Czechoslovakia) such maps take up about one-fifth of the available map space. This is evidently due to the fact that agriculture is an important segment of the sphere of material production.

Agricultural maps are not only of cognitive importance; they also constitute a valuable aid in the solution of general problems of planning aimed at the development and rational distribution of agriculture, the adoption of reclamation measures and the solution of other practical tasks.

Agricultural maps vary in their content, the character of the indices employed and the methods of presentation. This is due, on the one hand, to differences in social relations in the agricultural segment of the economy of various countries and differences in the level of development of productive forces, and, on the other hand, to the character of the internal organization of farm production. The content of agricultural maps depends also in many respects on the degree to which the given territory has been mapped. It is therefore all the more important to state the principles on which the agricultural maps were constructed.

The place of agricultural maps in national atlases is determined mainly by the degree of development of agriculture, its importance in social production and the geographical characteristics of the given country. In atlases of capitalist countries, agricultural maps usually follow after physical maps; in Socialist atlases usually after the section on industry. Since industry, and especially heavy industry, are decisive factors in the development of productive forces, we consider it correct to place agricultural maps in the section on the economy after maps on electric power and industry. (See K. A. Salishchev, "The purposes, contents and ways of improving national atlases," Abstracts of Reports at the Plenary Meeting of the Commission on National Atlases of the International Geographical Union, Moscow, 1958, p. 5.)

We can distinguish three basic groups of agricultural maps on the basis of the tasks of agriculture and the practice of representing them in national atlases: (1) maps of agrarian relationships; (2) maps of productive forces in agriculture; (3) maps of distribution and sizes of agricultural production (by sectors, crop groups and as a whole). Such a grouping corresponds to Marxist-Leninist theory on the social mode of production. We will now discuss the contents of such maps.

Maps of agrarian relationships. These maps get little attention in the national atlases of capitalist countries, and are entirely lacking in some (Egypt, India, British Columbia). A characterization of agrarian relationships requires showing the forms of ownership of the means of production in the form of appropriate maps.

The atlases of some capitalist countries (Sweden, France, Belgium) contain the following types of maps: forms of land ownership, for example, ownership by the state, companies, large and other types of landholders; land tenure (form of land lease, sizes of leases and rents); distribution and numbers of farms, grouped by sizes, and so forth. That is the extent to which agrarian relationships in the capitalist countries are indirectly characterized. A full-fledged characterization of class differences in agriculture would require cartographic representation of the following basic groups distinguished by Lenin: hired farm labor; small parcel lots, whose owners' income is derived mainly from other sources; small farms requiring no hired labor; middle-size farms requiring some hired labor; large farms relying entirely on hired labor; capitalist farms.

The land areas belonging to various class groups can be shown on a cartogram, and the number of farms in each group by the dot method. It is also desirable to show the distribution of land, livestock and farm implements among the class groups in the form of cartograms.

Atlases of Socialist countries show the collectivization of farming and the areas and distribution of land among state farms, collective farms, and so forth. Also of practical value are economic indices for farms of various social forms showing the distribution of land and other means of production, marketable and total farm production, and so forth.

The purpose of this group of maps is to show the dynamics of social phenomena, such as rates of collectivization, the degree of concentration of capitalist farm production, and so forth.

Maps of productive forces in agriculture. This includes, first, maps showing land as the basic means of agricultural production (land-use maps, land-classification or land-type maps, reclamation maps); second, maps showing the technical equipment of agriculture, and, third, maps showing agricultural manpower.

Land-use maps appear in each national atlas and are constructed along various principles. Relatively simple land-use maps are the small-scale map diagrams in the atlases of Lower Saxony and Finland, showing land-use by administrative units. They include cartograms of the relative share of various types of agricultural lands in the total land area: (a) arable land, including cropland, fallow, gardens and idle land; (b) hay meadows; (c) natural pasture; (d) perennial crops. Important indices are those showing changes in the structure of agricultural lands (increases in arable land through development of virgin and idle lands). Dot maps, which are much closer to

geographical reality, can also be used to show the actual distribution of various types of agricultural lands, as in the case of the map of distribution of arable land in the atlas of Sweden, where the size of the dot corresponds to the area to be represented at the map scale.

The most valuable method is the combined way of showing the distribution of the dominant types of agricultural lands. Such a method is used on multi-color land-use maps of Britain, the United States and Poland. The British land-use maps, for example, show the distribution of woods, arable lands, gardens and cultivated pastures, hay meadows, brushlands, swamps and natural pastures, orchards and tree nurseries, and lands in urban and transportation use.

Land-classification (land-type) maps showing the quality of land are of considerable practical importance. Such maps, included in the planned atlas of England and Wales and in the agricultural atlases of East Germany and the United States, show the distribution of lands that have similar characteristics from the tillage point of view, including natural soil fertility, the character of the relief, the degree and difficulties of agricultural utilization of the land, as well as the gross and net income derived from a unit area.

Land-classification (land-type) maps of the Socialist countries must include indices of the economic appraisal of agricultural lands, characterizing the results of economic utilization and appraising them in terms of uniform cost indices. Such an appraisal makes it possible to compare lands in the major use groups. Land-classification maps are still relatively rare in atlases and require further refinement of principles and compilation methods. The latter comment also applies to small-scale land-use maps.

National atlases also contain reclamation maps, which are essential for countries with unfavorable natural conditions, and maps showing measures to improve the chemical properties of soils.

The reclamation map of the USSR in the Great Soviet World Atlas deserves attention because it shows hydrologic regions, areas of widespread gullying, landslide phenomena, areas of swamp-drainage and irrigation works before and after the revolution, and areas of reclaimed lands.

The irrigation map in the atlas of India shows the distribution and expansion of irrigation areas over a period of 44 years, as well as engineering works and planned irrigation areas.

The most valuable maps are those showing the distribution of reclaimed lands in combination with selected physical-geographic characteristics, for example, the reclamation map in the atlas of British Columbia, combining the distribution of irrigated lands with precipitation.

Atlases quite often contain cartograms and dot maps showing the amount

of fertilizer applied per unit area and soil-liming needs, as in the case of the Belorussian atlas.

Land-use maps should also include large-scale maps showing the actual distribution of agricultural lands in various zones and regions, and maps or diagrams showing the territorial organization of various types of farms.

Maps of the technical equipment of agriculture (mechanization and electrification) are relatively new and therefore few in numbers.

Maps of this group, which are included in the atlases of Lower Saxony, the United States and France, essentially show the distribution and numbers of farm machines and the level of mechanization of production processes, such as planting and harvesting. Maps of electrification and electric-power supply in the Great Soviet World Atlas and the Belorussian atlas show the percentage of electrified farms and the capacity of mechanical engines and electric motors per 100 hectares of agricultural land (in horsepower). The maps are accompanied by graphs and diagrams showing the sources of farm power supply by types of power plants, the utilization of electricity by farms, and the rates of increase of the number of tractors, engines and trucks.

Maps of the technical equipment of agriculture should also show the amount of cultivated land per tractor or per harvester combine.

Maps of agricultural manpower. Manpower in national atlases is usually shown in the section on population. However, the section on agriculture might contain some important additional indices, such as the size of agricultural manpower and the number of persons employed in agriculture and subsidiary occupations, and the amount of arable land (in hectares) per farm worker.

Maps of the distribution and size of agricultural production show the basic segments of agriculture, major crops and perennial plantings, harvests, numbers and productivity of livestock, ratios between various segments of agriculture and the character of specialization.

Maps of this group should show: crop groups and individual crops -- by sown areas (dot method), their percentage in the total sown area (cartograms), crop yields in metric centners per hectares (cartograms); livestock -- distribution of types of livestock (dot method), preferably by comparable weights, with one dot representing, say, 500 head of cattle or 2,000 hogs or 500 sheep; the number of livestock per 100 hectares of agricultural land, and livestock productivity (average annual milk yield per cow, average annual wool yield per sheep).

Maps of types of specialization of agriculture are included in atlases of Socialist countries, but occur relatively rarely in atlases of capitalist countries.

This subgroup of maps has no uniformity either in content or in the methodology of determining agricultural regions and farm types. In Volume II of the Great Soviet World Atlas, for example, the general economic maps show agricultural specialization on the basis of statistical indices of production in kind. In atlases of capitalist countries, types of agriculture are distinguished on the basis of natural-historic factors, and in the atlas of the United States on the basis of farm incomes.

Maps of Socialist agricultural specialization are best compiled on the basis of production indices by value and in kind, such as the percentage of various segments of agriculture in the total value of marketable output.

The third group of maps should also show the rate of change of sown areas and livestock numbers, the introduction of new crops and livestock breeds, the long-range changes in the specialization of agriculture and the level of intensity of agriculture.

The content of agricultural maps should be related to maps in other sections of the atlases (physical geography, population, industry). Uniformity and comparability of maps can be achieved by judicious selection of scales, geographical map bases, method of selecting agricultural elements and the character of presentation.

The agricultural maps are usually compiled at smaller scales than the basic physical maps of the atlases. Actually an effort should be made to compile the main agricultural maps showing the distribution of crops and the types of agricultural lands at the same scale as soil and relief maps. Comparability of such maps makes it possible to appraise the suitability of existing land use and to determine possible improvements.

The selection of the cartographic method of representing agricultural elements depends on the character of their areal distribution.

The tendency in national atlases is to abandon the use of statistical methods (cartograms and map diagrams) in favor of methods showing the actual distribution of phenomena, such as refined cartograms and dot maps, and to use a combination of methods for showing interrelated phenomena on the same map. For example, crop maps in the atlas of Belgium use the dot method for showing the distribution of crops and a cartogram to show the percentage of each crop in the total sown area; livestock maps use the dot method for showing the distribution of livestock types and a cartogram for the number of livestock per unit area. In the atlas of natural resources of Australia, the livestock map combines the dot method for livestock distribution with a colored background for forage-land types and with directional lines for livestock drives.

The use of a colored background in conjunction with various symbols makes it possible to integrate the presentation of various related agricultural indices on a single map, as can be seen in the general economic and agricultural

maps of Volumes I and II of the Great Soviet World Atlas and in several other Soviet atlases.

The section of agricultural maps in national atlases should be accompanied by text explanations, including diagrams and photographs and methodological and source references.

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## GEOMORPHIC MAPPING ABROAD

By A. I. Spiridonov


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Several foreign countries have been publishing general geomorphic maps at medium and small scales (1:500,000 and less) based on available textual and cartographic materials. These maps can be found in atlases, monographs and articles of a regional geomorphic character.

Geomorphic maps at scales of 1:500,000 to 1:1,000,000 show relief by contours and colored background, shading and symbols to identify geomorphic regions, geological structures and their lithology, and elements and forms of the relief of various origins. Special attention is given to erosion surfaces. No definite rules have been worked out for compiling and presenting such maps, and a great diversification exists. In an analysis of the geomorphic maps of France, the Netherlands and Denmark, compiled by the editorial staff of the French national atlas, M. Lefèvre (16) notes problems of comparability in view of differences in content and in the use of conventional symbols.

On the morphologic map of France at 1:1,000,000, compiled by E. Martonne with the aid of other scholars and published in the French atlas (9), relief is shown by a colored hypsometric background with a very large contour interval. A green background is used to show alluvial plains situated in the lower range of the elevation scale, which is left without color. Several types of shading symbols are used to identify relief elements and forms, such as terraces, alluvial fans, moraines, valleys, summit ridges, plateau scarps and so forth. The shading colors vary with the character and age of the structures or with the origin of the relief.

In contrast to the map of France, the morphologic map of Belgium in the Belgian atlas (8), compiled by M. Lefèvre at 1:500,000, uses a colored background to identify major relief units: plains - green, Plio-Pleistocene slopes - yellow, and plateaus - brown, gray, red and violet. Colored conventional symbols are used to designate relief elements and forms of various origins. The principal relief macroforms and erosion surfaces identified on plateaus stand out sharply on the map. Closer examination reveals details of the geomorphic structure.

Similar types of geomorphic maps are found in other atlases. An example is the map of relief forms of Lower Austria (10) at 1:500,000, but instead of a colored background and colored symbols it uses only brown shading and blue symbols, which greatly reduces its legibility.

Quite a different approach has been used on the map of surface forms in the Italian atlas (7) at 1:2,500,000. It shows relief forms distinguished by origin: dunes, lagoon and delta forms, alluvial plains, terraced valleys, moraine forms, depositional volcanic plains, volcanic cones, erosion forms, glacial erosion forms, marine terraces and karst forms. Each genetic category is designated by its own color, except for erosion and glacial-erosion relief forms, which are further subdivided to rock types (granite, limestone and so forth). The map is very simple and legible, but suffers from the absence of structural-tectonic features and lacks designations of individual relief elements and forms, for example in the mountains, which look quite schematic (5).

The smaller the map scale and the greater the territory covered, the better are large geomorphic features identified on the maps. Such features are easily reduced to a single classification, which is usually based on

structural-lithologic and orographic criteria. O. Engeln's classification (11) can serve as an example. It was translated into Russian by M. V. Durdenevskaya (2). In using that classification, the compilers of geomorphic maps of large territories designate each classification unit by its own color so that related colors and shades stand out as relief categories of a single group. It was on such a principle that Engeln compiled the map of South America.

Increasing attention has recently been given abroad to detailed geomorphic studies accompanied by field work. Major projects of that type are under way in the people's democracies. We already had occasion to mention the large-scale Polish survey, based on a single legend and covering the whole country (4). The basic principles of that survey were discussed by M. Klimaszewski (15). According to regularly published reports, the Polish survey is proceeding successfully. Personal impressions of the project were also published by I. P. Gerasimov and Yu. A. Meshcheryakov (1).

Geomorphic mapping in Czechoslovakia is being done by the Geomorphology Office of the Czechoslovak Academy of Sciences under the direction of Prof. F. Vitasek. A general geomorphic map of Bohemia-Moravia has been completed, and a sample at the scale of 1:500,000 covering the Dyje-Svratka plain was attached to Vitasek's article (22). On the base of that map and its legend a large-scale survey was undertaken. The results of that survey are shown in the detailed geomorphic map of the Veverka River basin at 1:25,000 (18).

The map of Moravia is a general map, showing morphography, morphometry, genesis and age of the relief. Morphographic and morphometric features are shown by contours, elevation marks and symbols of the topographic base. In addition the map bears a square shading in which the size of the square denotes the depth of dissection of the relief. The thickness of the lines of the shading or the use of double lines indicate the stage of development of the relief and color identifies the principal agent of relief formation. Blue indicates erosion relief, green - marine, violet - volcanic, yellow-green - lacustrine, carmine - glacial and permafrost, brown - aeolian, brick red - karst, cinnabar red - gravitational, blue-gray - terrestrial deposits, and dark blue - biogenous deposits. Black is used for structural-tectonic forms. The same colors are used for symbols designating individual relief forms of different origins. The age of the relief is given by a geological base shown by a transparent color background.

The geomorphic map of Bohemia and Moravia thus makes an attempt to distinguish relief forms on the basis of a complex of indices in combination with their geological structure. The Czechoslovak scholars are seeking to improve the content and presentation of the map on the basis of the experience of the field studies and compilation work now under way. In our view, the present system could be improved by more complete and clearer representation of geomorphic elements through the use of colored background as well as colored shading.

The great theoretical and practical value of detailed geomorphic surveys is also realized in other countries. This is partly due to the widening recognition of the concepts of climatic and dynamic geomorphology, which require thorough study of relief forms and of relief-forming processes under various climatic conditions.

Of interest in that connection is the work of J. Tricart, the French geomorphologist, devoted to the methodology of constructing large-scale geomorphic maps from detailed field surveys (20,21). In Tricart's view, geomorphic maps at scales of 1:500,000 or smaller are primarily structural maps. Only large scales (1:100,000 and greater) make it possible to represent fully the complex combinations of contemporary and past relief-forming processes, and through them the dynamics of the relief, its past development and the trend of subsequent changes. Such maps can be successfully used for practical purposes and deeper scientific research.

A topographic map or, in its absence, an aerial photo map can be used as a base. Dot shadings of various dot sizes indicate unconsolidated deposits of various particle sizes, while line shadings indicate solid rock. Different patterns of dot symbols are used to designate the origin of deposits and depositional relief forms: circles of aeolian, triangles for marine, squares for stream deposition. The genesis of denudational forms is rendered by shading patterns. The strongest element of map representation -- the colored background -- is used by Tricart to designate the age of the relief. For greater legibility, age and facies (genetic) symbols (indices) are entered on the map. The Geography Department of Strasbourg University used these principles in a geomorphic survey of the delta of the Senegal River at 1:50,000 for the purpose of drafting irrigation plans.

In recent years geomorphic mapping has also been the subject of lively discussion among Swiss geomorphologists (6,19). The Swiss Geomorphological Society has proposed the organization of a systematic large-scale survey of the country. In 1947 a legend was worked out for a geomorphic map of the Swiss Alps; it was later supplemented and improved for use in the Jura. A legend has also been worked out for the survey of the Mittelland.

The following basic principles have been adopted for the Swiss geomorphic survey (6,12):

1. The map should provide a general geomorphic picture of the territory and its forms on the basis of the morphogenetic principle. The age of the relief, which is not always determinable, will not be shown. The map will also omit purely geological information, except for certain structural-tectonic elements (faults, folds, axes of folds, pitch and strike) required for an understanding of the relief.
2. The field survey sheets will be 1:5,000 to 1:10,000; the publication scale 1:25,000.
3. Relief is divided into denudational and depositional forms. Among the denudational forms, the map distinguishes valleys and their elements, erosion-denudational, glacial and karst forms and their elements (ridges,

brows, scarps and so forth). Among the depositional forms, the map distinguishes forms and elements of lacustrine, glacial, fluvial, aeolian and organic deposition. Anthropogenic forms are identified separately.

4. Denudational and erosional forms and their elements are shown by linear and dot symbols of a uniform color, depositional forms and unconsolidated deposits by red area shadings. All symbols will have distinctive patterns, thus making it possible to print the map in a single color without loss of legibility. The legend contains about 100 symbols.

At the same time the Swiss are working on a general geomorphic map of the country at 1:200,000, following the same principles used in the more detailed map (6,19).

The Swiss are thus omitting the use of a colored background, which tends to reduce the richness of content of the maps. This is especially true of the denudational relief, which is shown only by its linear elements.

Similar conventional symbols for geomorphic maps have been proposed by H. Lehmann(17). His table of symbols, in one color, distinguishes elements and relief forms and some groupings of forms by physiognomic and genetic criteria. The legend also includes relief categories for use in areas with more diversified geomorphic conditions, but the resultant map is essentially of the Swiss type.

We should also mention the Japanese program of geomorphic mapping. K. A. Salishchev (3) wrote about the publication in Japan of a series of special land-classification maps at 1:50,000, compiled by the Geographic Survey Institute for the various prefectures and the Economic Planning Department. The series includes six coordinated and mutually complementing maps: relief-form classification, angle of slope, valleys and density of the valley network, geology, soils, and bore holes. The first three can be regarded as geomorphic maps. Samples (the 1956-57 survey of the Tomioka area) were exhibited by K. A. Salishchev at a meeting of the cartography division of the Moscow Branch of the Geographical Society of the USSR.

Of special interest is the map of relief-form classification. On a topographic base showing relief by contours, a colored background is used to distinguish gentle and steep slopes differentiated by degree of horizontal dissection (depending on the number of erosion forms per square kilometer), gravelly and rocky river terraces at various levels, floodplains, alluvial fans and dry valley bottoms. Symbols are used to mark rock and mud flows, landslides, talus cones, sand and gravel hills. Letter indices are used to designate superficial deposits, such as accumulations of boulders, gravel, sand, silt and clay. In terms of its content this map corresponds best to the concept of general geomorphic map despite the fact that the genetic principle is not observed consistently. Mountain and hill relief is classified mainly on the basis of morphographic and morphometric criteria, which results in partial duplication of the two other purely morphometric maps.

Geomorphic field surveys in recent times have covered large areas in central and southern Africa. A general idea of the results is given by the map of erosion cycles in central and southern Africa at 1:7,500,000, compiled by L. King on the basis of field data (14). A colored background on the map distinguishes relief-form complexes of different erosion cycles: Gondvana, African, Victoria and Congo. A similar map has been compiled by King at 1:2,000,000 for eastern Brazil.

An example of the large-scale mapping of erosion surfaces that is widespread abroad is given by L. Hempel's work (13). At a scale of 1:150,000 he distinguishes several stages of old erosion surfaces, structural surfaces, areas of Quaternary erosional dissection and Quaternary river terraces.

This review does not, of course, exhaust all geomorphic maps recently published abroad. But it shows by some examples that the problem of geomorphic mapping is attracting increasing attention among foreign scholars. From the compilation of small-scale maps based mainly on published data, some countries have proceeded or are in the process of proceeding to the organization of geomorphic field surveys and the compilation of large-scale maps. Of particular interest in that connection is the experience of Poland, Czechoslovakia, Switzerland and Japan. An especially valuable contribution is being made by Polish geomorphologists, who are combining the representation of relief on the basis of several criteria (morphography, morphometry, genesis and age) and have already covered a large part of their country with their field survey. The geomorphic map is being used in Poland to solve major economic development problems.

Also of interest are the detailed symbols worked out in some countries for designating relief elements and forms, the maps of erosion surfaces and of structural-morphologic regions. However the problem of geomorphic mapping as a whole (unification of content and presentation at various scales, problems of generalization, and so forth) still requires further elaboration.

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## BIOCLIMATOLOGY AS A SCIENTIFIC DISCIPLINE AND ITS CURRENT OBJECTIVES

By A. M. Shul'gin

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Bioclimatology is concerned with the study of the bioclimate of various groups of living organisms. By bioclimate we mean those climatic conditions which (together with other environmental factors) determine the existence, growth, reproduction and distribution of living organisms. The concept of bioclimate must be differentiated from that of climate, microclimate or phytoclimate. The climate of a given place is the average weather conditions characteristic of that place over a number of years, being produced by solar radiation, the character of the underlying surface

and the related circulation of the atmosphere (1; p. 9). The microclimate is the local climatic characteristics produced by the non-uniformity of the underlying surface (1; p. 11) and the phytoclimate is the microclimate of crops directly dependent on those crops (23; p. 90).

The study of climate, microclimate and phytoclimate is designed to establish the natural laws of those phenomena over time and in space, and their genesis under the influence of the environment and man's activity. However, climatology is not concerned in detail with the relationships between living organisms and the climate, or their latter's influence on the growth, development and areal distribution of plants and animals. This aspect of the interaction between climate and its living environment is, however, of great practical and theoretical interest not only for climatology, but for biology and agriculture.

The need for investigating the influence of climate on vegetation was already pointed out by A. I. Voyeykov. He laid down the following principles: "We can assume that for every plant there is a certain distribution of light, heat and moisture that corresponds most ideally to its present organization and provides the best conditions for development. If we then look upon the plant's organization, we find that it can withstand certain deviations of those ideal conditions; once these limits are exceeded, the plant can no longer survive" (7; p. 383).

The development of ideas concerning the interrelationships between plants and their environment has made it possible to establish certain principles that supplement Voyeykov's views.

The relationships between plants and climate reflect to a certain extent past climatic conditions that gave rise to and supported the existence of living organisms in the first place. In the process of their historical and individual development, plants select from the environment certain factors vital for their existence, including certain climatic factors (light, heat, moisture). It is precisely these factors that require study.

Besides conditions for the existence and development of organisms, the environment also contains secondary factors that have a certain indirect or direct influence on organisms at individual moments of their life. There are also factors in the environment of organisms that do not affect their development.

Climatic conditions needed for the existence of one group of plants may be not at all or only slightly necessary for other groups of plants.

Organisms need various combinations of climatic conditions in the course of their life. A major principle of modern biological science is that the development of organisms consists of several periods with different characteristics -- developmental stages, organogenetic stages and growth phases. For each developmental stage and for the formation and functioning of each

organ, plants need a certain combination of climatic (and other) conditions. In addition, the transition to a new stage in the life of plants requires the presence of the leading climatic element in a certain ratio to other elements, enabling the organism to make that transition to the new stage.

Growth and development of organisms are not identical. The combination of climatic (and other) factors needed for growth seldom coincides with the conditions required for plant development. It is therefore especially important to distinguish these conditions both in nature and especially in cultivation.

The climatic conditions for the existence of organisms are not unchanging, nor do they act one-sidedly on the life processes of plants. Having arisen and developed in a certain climate of a given geographic zone, organisms change the climatic conditions of their further existence in the surface layer of the air and the soil and actively adapt themselves to these conditions. The changing conditions may produce new transformations of the organisms in the process of their historical development. Both climatic and especially microclimatic conditions undergo periodic fluctuations and changes of substantial importance for the life of organisms. Thus, if the climate, together with food and other conditions of life, is a factor in the existence and development of plants, the latter, developing under certain climatic conditions, will in turn change the phytoclimate and the bioclimate.

This idea has been very well expressed by B. A. Keller. "Just imagine," he wrote, "the life phenomena of the plant world of our planet in a concrete natural environment. Literally at every step there is an inexhaustible, incalculable richness and variety of all kinds of adaptive reactions and constant changes in the individual development of plants depending on the eternally changing conditions of their existence. Whether plants stay in one place or whether they migrate, their relationships with the environment, including other plants, are constantly changing. And this in turn produces definite reactions and changes in the plants...We are thus confronted by a grandiose, magnificient, all-pervading process of change and transformation of the life of plants under conditions that are eternally changing and are in turn eternally changed by the plants themselves" (12; p. 12).

The bioclimate of plants also changes under the influence of man, who through changing tillage practices, seed selection, and so forth, changes the character of the organisms and regulates their environment.

## The History and Place of Bioclimatology

Bioclimatology is a division of science at the border line between biology and climatology. While biology is concerned with the natural laws governing the life and development of organisms and climatology studies the formation and geographical distribution of climates, bioclimatology deals with the relationships between plants and climatic conditions. Thus far problems of bioclimatology have been studied by various scientific disciplines, especially by one of the branches of biology -- phenology.

According to Hopkins (29), bioclimatics is concerned with the relationships between the processes of living nature, climate, the march of time and geographical location. In his Bioclimatics, which is the result of long research, Hopkins formulates a bioclimatic law establishing mean values for changes in the times of seasonal biological phenomena with changes in latitude, longitude and elevation. V. R. Ekkardt (28) understands by bioclimatology the science dealing with the relationships between living organisms (including man) and climate, and gives that concept a very broad sense. V. A. Batmanov (4) holds that bioclimatology is a geographical science concerned with the distribution of bioclimatic types over the earth's surface over time and in space. According to N. P. Smirnov (20,21), N. S. Shcherbinovskiy (27) and others, bioclimatology is identical with general phenology -- the science of the annual cycle of biological phenomena.

Since various processes in the life of plants proceed under the influence of climatic conditions, the seasonal development of living nature serves as an indicator of a change in weather conditions, and the plants are distinctive climate indicators. Many phenologists therefore regard the study of phenological phenomena -- the time of the start of phenophases, the length of inter-phase periods and their sequence in time and in space -- as the study of the bioclimate of individual rayons and oblasts, and the compilation of phenological maps as the making of bioclimatic maps.

For example, the bioclimatic map of the Urals, according to V. A. Batmanov (3), represents the springtime development of vegetation in terms of the average date of the start of seven phenological phenomena -- the flowing of birch sap, the greening of the bird cherry and the birch, and the flowering of the bird cherry, the Siberian pea tree, the lilac and the mountain ash. The bioclimatic maps and the curves drawn by N. P. Smirnov (20,21) give the difference in days between the flowering dates of a whole group of plants in various places of Europe and the USSR and the dates of those phenomena at Stavanger, Norway.

In these and other interesting phenological studies, the examination of specific processes in the seasonal development of living nature fails to disclose the causal relationships between these processes and climate in the form of quantitative indices and does not take account of the biological characteristics of each group of organisms. Having as its objective the study of the laws of the seasonal development of nature, phenology, though close to bioclimatology, therefore does not solve all the problems that fall within the compass of bioclimatology.

The founder of bioclimatic research in Russia was A. I. Voyeykov, who first proposed simultaneous and correlated meteorological and phenological observations. He observed natural phenomena over a period of ten years and published the results from 1887 to 1895 (8). Interesting observations were also conducted by A. I. Kaygorodov, V. A. Poggenpol' and others.

The study of the bioclimate is also part of agroclimatology. Much has been contributed to the study of the bioclimate of cultivated crops and woody plants by the Soviet agrometeorologists and agroclimatologists G. Z. Ventskevich (6), F. F. Davitaya (9), P. I. Koloskov (13), A. I. Rudenko (17), V. N. Stepanov (22), A. A. Shigolev (25) and others. They studied the relationship between the rate of growth of plants and the air temperature; they established plant requirements in terms of the sum of active and effective temperatures during the entire growing season or parts of it, and they determined critical temperatures for the life activities of plants. The so-called bioclimatic constants obtained through this research have played an important, though auxiliary role in solving problems of agrometeorology and agroclimatology.

A practical objective of agrometeorology at the present time is to forecast climatic phenomena affecting crop production and to develop a system of measures and methods to make rational use of favorable aspects and to overcome unfavorable aspects of climate. The principal task of agroclimatology is to study the climatic characteristics and resources of an area as a base for the distribution of crops and cropping systems (14).

Interesting and important bioclimatic research is also being conducted in the field of resort planning. Bioclimatic problems fall also partly within biogeography. Bioclimatology is also very close to agrobiology, which is concerned with the requirements of crops to all environmental factors and established qualitative changes in the life cycle of plants for the purpose of guiding the process of development. On the basis of the achievements of biology and by helping to solve many of these problems, bioclimatology must establish quantitative characteristics of the relationships between plants and other organisms and the main climatic conditions.

Many problems of bioclimatology have thus far been worked out by both biological and geographical disciplines. Further development of bioclimatology must be achieved through more detailed studies of the bioclimate, which would seem to justify making bioclimatology a branch of climatology.

## Research Objectives

The objective of bioclimatic research is to achieve a steady increase in the productivity of agriculture. The important thing at the present time, in our opinion, is not so much the forecasting of unfavorable climatic phenomena or the times of individual phenophases (although this is also necessary) as the regulation of microclimatic conditions during the plants' vegetative period (and in the winter) with the aim of increasing their productivity. This shows the need for detailed research on the bioclimate of individual crops during their entire life. This research is also important for agrometeorology and agroclimatology, which base much of their research on bioclimatic constants.

The available literature on the relations between plants and climate

(6, 13, 18, 22, 24) is still inadequate to meet all current needs. The introduction of new plant varieties and tillage methods requires the checking of a wide range of data. Moreover, the relations between plants and climate have been expressed in terms of the sum of temperatures for the entire growing season corresponding to plant-growth phases. However, the developmental phases used thus far in phenology and agrometeorology are external features of plant development; in many cases they fail to disclose the internal qualitative changes that take place in the organism and determine its productivity. Modern biology looks at the cycle of plant development in terms of organogenetic stages, each of which requires special environmental conditions. The study of bioclimate therefore also requires that these stages of plant development be taken into account (14,15).

Until recently bioclimatic research established relations between plant development and one or two climatic factors, usually the air temperature, as well as soil moisture. Other factors such as light (the duration of daylight, light intensity, spectral composition) and the temperature of the surface soil layers have been virtually ignored. Nor was much attention given to the combination of climatic elements essential to the plants at any given period of their development or growth, and to the leading elements of that climatic combination. This problem is undoubtedly complicated, but it requires further study.

Bioclimatology thus faces the following tasks: (1) study of the bioclimate of major groups of cultivated crops and useful wild-growing plants by developmental stages in various geographical zones with the aim of raising productivity, improving quality of output, acclimatization and regionalization; (2) study of the general relations between living organisms and climatic conditions; (3) computation of indices expressing the requirements of groups of organisms to the aggregate of climatic conditions and its leading elements.

## Research Methods

Bioclimatology should adopt the methods of climatology and biology, such as the following:

(1) The method of parallel observations of plant behavior and meteorological conditions. This method was introduced by P. I. Brounov and is widely used at agrometeorological stations. It establishes the existence of parallel phenomena but does not always make it possible to determine the relations between phenomena and the role of individual climatic factors.

(2) The method of simultaneous observations of the march of meteorological conditions and the behavior of plants sown at one place at various repeated intervals (every 3, 5 or 10 days). The method of repeated plantings is an improvement of the preceding method. It is widely used by agrobiologists and agroclimatologists. Its advantage lies in the fact that it exposes plants to different weather conditions at each stage of plant development, making it possible to establish the influence of individual climatic factors and their combinations on plant growth.

(3) The method of coordinated observations during the growing season of the march of climatic conditions and the behavior of plants at different geographical locations. This method helps establish relations between plants and climate, especially when used in conjunction with the preceding method.

(4) The method of experimental laboratory observations in an artificial climate. It makes it possible in a short time to reproduce a variety of climatic conditions and their combinations and to determine plant reactions. It has certain limitations in simulating natural conditions.

(5) The experimental field method makes it possible to study more exactly the role of climatic elements and their combinations at various stages of plant life under natural conditions. It involves to varying degrees the use of Methods 1, 2, and 3 in order to produce for periods of varying lengths changes in light, air and soil moisture, and temperature (by covering the plants with periodic light chambers, by the use of mulches, irrigation, changes in the height of the snow cover, freezing of the plants, and so forth).

The wide adoption of such experimental methods will make it possible to uncover many relations between plants and climate that would be of great theoretical and practical importance and will raise bioclimatology to a higher level.

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## SOVIET COMMENTS ABOUT SOVIET GEOGRAPHY

(From Izvestiya Akademii Nauk SSSR, seriya geograficheskaya, 1960, No. 3, Page 137)

The American Geographical Society has taken an important step to acquaint the geographers of the United States and other countries using English in their scientific intercourse with the work of Soviet geographers. Since the beginning of 1960 the Society is publishing a special journal titled Soviet Geography: Review and Translation. The journal's advisory committee includes well-known United States geographers, some of whom have spent time in the USSR and have had occasion to acquaint themselves first-hand with the state of Soviet geography (C. D. Harris, W. A. D. Jackson, H. L. Kostanick) while others (for example, G. B. Cressey, T. Shabad, D. Hooson) have become known in the United States as specialists on the geography of the USSR.

In the first issue of the journal (a combined January-February number) the editors announce that the publication is being undertaken "in the conviction that the dissemination of the fruits of Soviet geographic research would be a service to American geographers and would help bring about professional contacts between geographers of the two countries." The American Geographical Society, whose initiative is supported by the National Science Foundation, plans to publish ten issues a year of about 80 pages each, using that space mainly for translations from Izvestiya Akademii Nauk SSSR, seriya geograficheskaya; Izvestiya Vsesoyuznogo Geograficheskogo Obshchestva and Voprosy geografii.

The first issue of the journal on hand thus far does not yet provide a complete idea of the character of the publication. At a future date we propose to review the journal more fully. -- V. V. Pokshishevskiy.

(From Geografiya i Khozyaystvo, 1960, No. 7, Page 55)

A special journal of translation and review of current Soviet geographical literature has started publication in the United States. The first issue (a double issue for January-February 1960) has already appeared. There will be ten issues a year, of 80 pages each. American geographers, as well as English-speaking geographers of other countries, will thus receive annually 800 pages of text of Soviet geographic studies.

The first issue contains translations of articles by I. P. Gerasimov, D. V. Kravchenko, E. M. Murzayev, Ya. D. Zekkel', S. N. Ryazantsev, Yu. P. Parmuzin, M. I. Pomus and V. V. Pokshishevskiy, a translation of A. V. Sokolov's review of the forest map of the USSR, news notes written by T. Shabad, editor of the journal, and the tables of contents of recent issues of the Soviet periodicals Izvestiya Akademii Nauk SSSR,

Izvestiya VGO, Vol. 45 of Voprosy geografii and the latest issue of Geografiya v shkole.

An editorial statement says that the new magazine will help establish professional contacts between geographers of the two countries. Such a suggestion can only be welcomed. Publication of the journal Soviet Geography in New York shows that Soviet geographic science has grown to such an extent that it required a special journal in the United States to publicize its work. The publication also shows that American geographers are interested in what is happening abroad, especially in research carried on in the Soviet Union.

We wish the new journal much success. -- Yu. Saushkin

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## NEWS NOTES

By Theodore Shabad

Economic Coordinating Councils. Following in the wake of the establishment of a Russian Economic Council and a Kazakhstan Economic Council (Soviet Geography, October 1960, p. 81) is the establishment of a Ukrainian Economic Council in July 1960. The Ukrainian council, like its counterparts in the RSFSR and in Kazakhstan, will coordinate the activities of the 14 regional economic councils of the Ukraine (for a list of these councils, see Soviet Geography, September 1960, p. 83).

As part of the coordinating program, the five regional economic councils of Uzbekistan have been abolished and a republic-wide Uzbek Economic Council was established in July 1960. The other Soviet republics also consist of one economic council each.

First Copper Ore Shipped From Gay. The first ore shipment from the new copper-mining center of Gay, northwest of Orsk, in the southern Urals, has reached the near-by copper smelter of Mednogorsk. (For further details about Gay, see Soviet Geography, May 1960, p. 88).

Saratov-Penza Natural-Gas Pipeline Opens. Construction of the natural-gas pipeline from Saratov to Gor'kiy has reached Penza, about one-third of the way to Gor'kiy. The pipeline, which carries natural gas from fields in the Saratov area, is one of the main pipeline projects of the Seven-Year Plan (1959-65).

Nevinnomyssk Gas-Fueled Power Station Opens. The Nevinnomyssk electric power station, which opened in June 1960, is the first large Soviet power plant fed by natural gas. Nevinnomyssk, a city in the Northern Caucasus, south of the Stavropol' gas fields, is situated on the Stavropol'-Groznyy gas pipeline. Natural gas is also a raw material for the industries of Nevinnomyssk, which include a nitrogen fertilizer plant.

Karaganda Iron and Steel Plant Opens. The first blast furnace of the Karaganda Iron and Steel plant went into operation in July 1960. Construction on the plant began in 1956; full operation with an annual steel capacity of 3,500,000 tons is planned for 1964. The plan is situated a few miles north of Karaganda, near the suburban city of Temir-Tau. A small steel plant (without blast furnaces) has been in operation at Temir-Tau since 1945 and has a capacity of about 250,000 tons of steel. The new Karaganda plant is based on local coking coal and on iron ore from Karazhal.

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Articles of interest to geographers appear in the Soviet monthly trade journal Koks i Khimiya (Coke and Chemistry), published in English translation by The Coal Tar Research Association, Oxford Road, Gomersal, Leeds, England. Annual subscription: £ 5.5s. Single issue £ 1.0s. Recent articles include:

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Articles of interest to geographers appear occasionally in the Soviet monthly trade journal Vestnik Mashinostroyeniya (Russian Engineering Journal), published in English translation by Production Engineering Research Association, Staveley Lodge, Melton Mowbray, Leicestershire, England. Annual subscription: £9.12s. 0d. Single issue: £1.7s. 0d. Recent articles follow:

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